Forest Insect and Disease Conditions in the United States 1975

PSW FOREST AND RANGE EXPERIMENT STATION

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Forest Service

U.S. Department of Agriculture

FOREWORD

The 1975 issue of the Forest Insect and Disease Conditions Report represents the 25th edition of this publication. The original objective has continued during this period to provide incidence and distribution information for forest insects and diseases occurring throughout the United States. During these years an increasing effort has been made to obtain and report damage and loss information pertaining to forest insect and disease outbreaks. Admittedly, we have a long way to go before accurate and timely loss and economic impact information will be available. Recognition of this fact, however, provides the incentive for forest insect and disease research and management specialists to direct their attention toward developing and applying impact survey technology.

The pest incidence and distribution information presented in this report was obtained from cooperating Federal and State forest insect and disease management specialists throughout the country. Through continuing surveillance and detection activities, forest managers are provided with information on insect and disease outbreaks as they occur. In the future, the close working relationship between the Forest Service and cooperating State forestry agencies, coupled with the continued vigilance of on-the-ground foresters and woods workers, will be especially important as demands for forest resources intensify.

The estimated volume of wood in trees killed during fiscal year 1975 as a result of major forest insect outbreaks was approximately 15.5 billion board feet. Based on a national average of $60 per thousand board feet, the value of this wood was approximately $930 million. In 1970, the calculated national average for the board foot equivalent of all wood products included in the construction of a single house was 17,000 board feet. Losses to major forest insects, therefore, in fiscal year 1975, were approximately equivalent to 911,700 houses. During that same period, money spent by Federal, State, and local forest managers on suppression of the major forest insects exceeded $11 million.

The need for more accurate estimates of losses and total impact on all forest resources is becoming more essential for use in forest management planning. Subsequently, in 1975 the Forest Service began planning the establishment and staffing of a Methods Application Group whose responsibility would be to identify, evaluate, and help implement new impact survey technology. An additional responsibility of the MAG would be to provide technical assistance to Federal and State forest insect and disease management specialists for pilot projects that would evaluate promising chemical and nonchemical suppression technologies for forest pests.

We would like to acknowledge the assistance of all State and Federal cooperators who provided the information, and specifically recognize the efforts of Dr. Terrance J. Rogers in helping to compile and edit this report.

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Staff Pathologist
Kenneth H. Knauer
Staff Entomologist

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This publication reports activities involving pesticides. It does not contain recommendations for their use, nor does it imply the uses discussed here have been registered. All uses of pesticides must be registered by appropriate States and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife–if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others which may be suitable.

Issued November 1977

THE NATIONAL
PACIFIC NORTHWEST REGION
PACIFIC NORTHWEST
PORTLAND
OLYMPIC
MT BAKER
OKANOGAN
COLVILLE
KANIKSU
KOOTENAI
WENATCHEE
SNOQUALMIE
GIFFORD PINCHOT
WASH.
MT HOOD
SIUSLAW
UMATILLA
WALLOWA
WHITMAN
CROOKED RIVER
WILLAMETTE
UMPQUA
SISKIYOU
OCHOCO
DESCHUTES
MALHEUR
ROGUE RIVER
FREMONT
OREG.
KLAMATH
MODOC
SIX RIVERS
SHASTA TRINITY
LASSEN
MENDOCINO
PLUMAS
TAHOE
PACIFIC SOUTHWEST
ELDORADO
TOIYABE
STANISLAUS
CALAVERAS BIG TREE
SAN FRANCISCO
SIERRA
CALIFORNIA
SEQUOIA
INYO
LOS PADRES
REGION
LOS PADRES
CALIF.
ANGELES
SAN BERNARDINO
CLEVELAND
COEUR D'ALENE
FLATHEAD
ST JOE
LOLO
LEWIS AND CLARK
NORTHERN REGION
MISSOULA
CLEARWATER
LOLO
HELENA
LEWIS AND CLARK
MONT.
DEER LODGE
NEZPERCE
BITTER ROOT
PAYETTE
SALMON
BEAVERHEAD
GALLATIN
CUSTER
CHALLIS
BOISE
SAWTOOTH
IDAHO
TARGHEE
TETON
SHOSHONE
BIGHORN
THUNDER BASIN
WYO.
BLACK HILLS
S. DAK.
FORT PIERRE
BUFFALO GAP
OGLALA
NEBRASKA
SAMUEL R. McKELVIE
NEBRASKA
NEBR.
LITTLE MISSOURI
N. DAK.
SHEYENNE
CEDAR RIVER
GRAND RIVER
HUMBOLDT
CARIBOU
CURLEW
CACHE
OGDEN
INTERMOUNTAIN
BRIDGER
WASATCH
ASHLEY
UINTA
NEV.
INTERMOUNTAIN
REGION
HUMBOLDT
TOIYABE
FISHLAKE
MANTI-LA SAL
UTAH
DIXIE
MANTI LA SAL
MEDICINE BOW
ROUTT
PAWNEE
ROCKY MOUNTAIN
ROOSEVELT
ARAPAHO
DENVER
ROCKY MOUNTAIN
REGION
WHITE RIVER
GRAND MESA
PIKE
UNCOMPAHGRE
GUNNISON
SAN ISABEL
COLO.
KANS.
SAN JUAN
RIO GRANDE
COMANCHE
CIMARRON
CARSON
KAIBAB
SOUTHWESTERN
REGION
CIBOLA
SANTA FE
KIOWA
RITA BLANCA
COCONINO
PRESCOTT
SITGREAVES
ALBUQUERQUE
N. MEX.
TONTO
APACHE
CIBOLA
ARIZ.
GILA
LINCOLN
CORONADO
CORONADO
BLACK KETTLE
LAKE MC CLELLAN
OKLA
LYNDON B. JOHNSON
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ALASKA REGION
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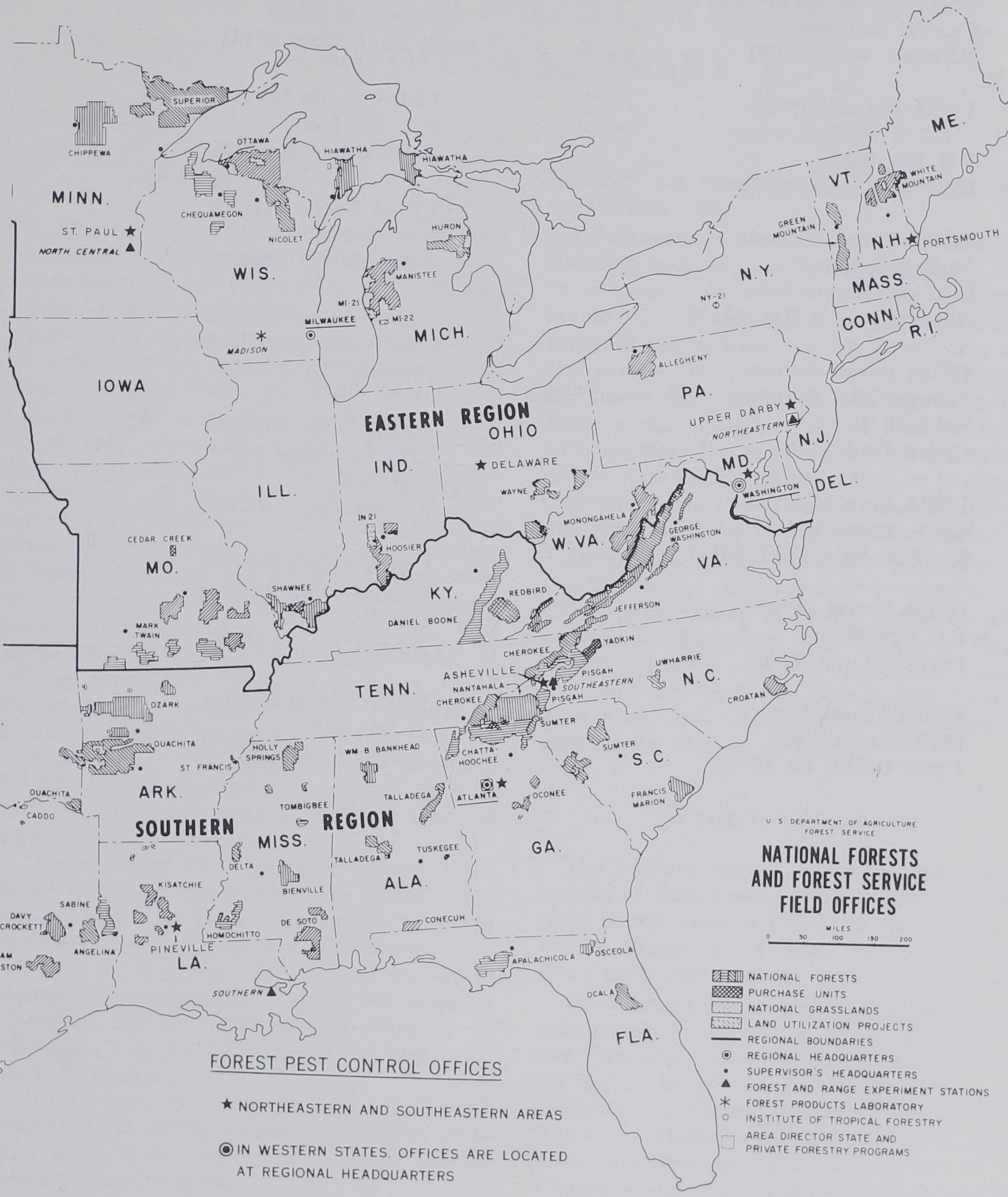
FOREST SYSTEM



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FOREST SERVICE

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FOREST PEST CONTROL OFFICES

★ NORTHEASTERN AND SOUTHEASTERN AREAS

◉ IN WESTERN STATES, OFFICES ARE LOCATED AT REGIONAL HEADQUARTERS

Forest Pest Control offices are located at the following addresses; see map on pages iv and v.

USDA Forest Service
Federal Building
Missoula, Mont. 59801

USDA Forest Service
11177 West 8th Avenue
P.O. Box 25127
Lakewood, Colo. 80225

USDA Forest Service
Federal Building
517 Gold Avenue S.W.
Albuquerque, N.Mex. 87101

USDA Forest Service
Federal Office Building
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Asheville, N.C. 28803

USDA Forest Service
2500 Shreveport Highway
Pineville, La. 71360

USDA Forest Service
1720 Peachtree Rd.
Suite 800
Atlanta, Ga. 30309

USDA Forest Service
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P.O. Box 1628
Juneau, Alaska 99801

USDA Forest Service
80 Daniel St.
Portsmouth, N.H. 03801

FOREST INSECT AND DISEASE CONDITIONS IN THE UNITED STATES, 1975

NATIONAL SUMMARY

Eastern Conditions

The spruce budworm, gypsy moth, fall cankerworm, and southern pine beetle continued to top the list of insect pests in the Eastern United States. Defoliation of more than 5 million acres by the spruce budworm prompted an aerial chemical control project covering 2.2 million acres in Maine this year. Acreage defoliated by the gypsy moth, however, dropped off sharply, especially in New England and New York, where the 91,000 acres defoliated represented only 60 percent of the 1974 defoliation. Fall cankerworm outbreaks occurred throughout the Northeast, especially in Pennsylvania, New York, and Wisconsin, where over 750,000 acres were defoliated. The southern pine beetle continued as the most serious pest in the South. This recent outbreak exceeded 46 million acres, and expanded from 11 to 13 States, causing moderate to severe damage in Kentucky and Oklahoma for the first time.

In the Lake States, defoliation of jack pine by the jack-pine budworm dropped off sharply, with Michigan reporting only 35,000 acres of light to moderate defoliation.

Overall, forest tent caterpiller activity in the South decreased, but in the Lakes States, populations appeared to be increasing. Increased defoliation on 25,000 acres was reported in two counties in Virginia, and partial to severe defoliation was reported on 200,000 acres in Louisiana and on 75,00 acres in Alabama. In Michigan, over 200,000 acres of oak and aspen were defoliated.

Other insects of note in the East were the oak leafroller, oak sawfly, balsam woolly aphid, hemlock woolly aphid, ips engraver beetle, and the black turpentine beetle.

Root rots, foliage diseases, and fusiform rusts continued to cause severe damage in conifer and hardwood nurseries. Cylindrocladium root rot was reported from Puerto Rico for the first time.

Other diseases of concern included oak wilt, Annosus root rot, and comandra blister rust. In general, oak wilt was static to slightly higher. The Huron-Manistee National Forest reported oak wilt for the first time in the central part of the Lower Peninsula of Michigan, and losses seemed to be intensifying in several State parks. Comandra blister rust continued to cause mortality to young loblolly plantations on and near the Cumberland Plateau in eastern Tennessee, and to young shortleaf plantations and natural stands in northern Arkansas.

Dutch elm disease incidence increased, especially in the Lake States. Predictions for 1976 are for heavy mortality in the northern sections of Minnesota, Wisconsin, and Michigan. Scleroderris canker caused severe damage and mortality in 60- to 80-foot high trees in New York. The pattern of damage closely resembled the situation in Europe.

Western Conditions

The western spruce budworm and several species of bark beetles were the major insect pests in the western forests of the contiguous United States. In Alaska, the spear-marked black moth remained the major insect pest.

The western spruce budworm defoliated approximately 5 million acres in Montana, Idaho, and Wyoming. Visible defoliation extended over 3.9 million acres of the northern Region, exclusive of the Nezperce National Forest, Idaho. Budworm infestations also intensified in Douglas-fir and true fir stands on portions of the Okanogan and Wenatchee National Forests and the North Cascades National Park in north-central Washington, with the area of severe defoliation exceeding 500,000 acres. Scattered

light to moderate defoliation occurred on 8,400 acres on the Wallowa-Whitman National Forest in northeastern Oregon and on 10,560 acres on the Warm Springs Reservation, Oreg. Populations were beginning to build up in Arizona and New Mexico.

The modoc budworm infestation in California, first reported in 1973, declined in 1975. Several other insect pest populations, however, expanded. The Jeffrey pine needle miner also enlarged its area of activity in the San Bernardino Mountains of southern California.

The 1974 Douglas-fir tussock moth epidemic in northern Idaho collapsed as a result of spraying with DDT, parasitism, predation, and disease. Tussock moth infestations, however, caused light to heavy defoliation on the Tonto National Forest, Ariz., and on the Cibola and Lincoln National Forests, N. Mex. No tussock moth defoliation was observed in either Washington or Oregon.

In the Alaskan interior, the eastern larch beetle continued to cause scattered tamarack mortality on 350,000 acres, and for the second year, the spear-marked black moth continued to defoliate over 2.5 million acres of paper birch. The western blackheaded budworm population decreased markedly to approximately one-half that of 1974. Larch casebearer defoliation was heavy on approximately 25,000 acres in northern Idaho.

Mountain pine beetle in many forested areas continued to cause heavy damage to stands of lodgepole pine and ponderosa pine and, in localized areas, to western white pine throughout many areas of the West. Beetle populations were high in lodgepole pine stands on the Lolo, Kootenai, Beaverhead, and Gallatin Forests, Mont., and are expected to intensify in 1976. Severe infestations were also detected in Glacier National Park, Mont., and Yellowstone National Park, Wyo. Populations on the Targhee and Ashley Forests in Idaho declined.

The heavy outbreak of the mountain pine beetle continued in ponderosa pine stands along the Front Range of Colorado (1 million trees), in the Black Hills of South Dakota (850,000 trees), and in Wyoming (6,000 trees). Heavy infestations also caused severe lodgepole pine mortality on 920,000 acres on the Umatilla, Wallowa-Whitman, and Malheur Forests, Oreg. On the Kaibab Plateau, Ariz., the mountain pine beetle infestation continued to intensify on about 8,000 acres.

Fir engraver damage more than doubled in Washington and increased nearly fivefold in Oregon. Heavy fir engraver damage was also detected throughout most of northern Idaho and western Montana, where over 1,630 grand fir were killed. An estimated 10,000 additional grand fir trees were killed along the St. Maries and North Fork Rivers.

Spruce bark beetle infestations were high over a 167,000-acre area on the west side of Cook Inlet, Alaska, but in other areas the infestations appeared to be declining.

Douglas-fir beetle infestations decreased noticeably in Idaho, Montana, Colorado, and California, but increased in Washington and Oregon, with some indication of increased activity in the Douglas-fir tussock moth areas.

The incidence of foliage disease and weather injuries continued to cause damage in both forest nurseries and forest stands in Washington. Root rots, heart rots, and dwarf mistletoe remained the most important diseases in the Pacific Northwest.

Dwarf mistletoe continued as the most destructive disease agent in the Rocky Mountain area of the West. In Colorado and Wyoming, approximately 50 percent of the commercial lodgepole pine forest is considered to be infested with dwarf mistletoe.

In Wyoming, 250,000 acres of commercial forest lands were heavily damaged by comandra blister rust. Severe aspen decline and mortality were also reported in the central Rocky Mountain Region in many recreational sites, with much of the decline due to camper abuse.

Foliage disease *(Phoma)* killed 4 million Douglas-fir seedlings in the Humboldt Nursery, Calif. In Washington and Oregon, mortality of Douglas-fir seedlings was caused by several species of *Phytophthora* in forest nurseries.

Smog damage to pines continued to increase in southern California and in the Sierra Nevada forests. Acute sulfur dioxide injury to forest vegetation from copper smelter emissions was observed on the Apache-Sitgreaves and Tonto National Forests, Ariz. Injury was limited to tip burn on conifers and interveinal bleaching and/or browning on broadleaf plants. Chloride toxicity continued to affect roadside trees on Cibola and Sante Fe Forests, N. Mex.

FOREST INSECT AND DISEASE CONDITIONS BY REGION

ALASKA (R–10)

by

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Conditions in Brief

The spruce beetle remained active on the west side of Cook Inlet near Beluga Lake and the Chakachatna and McArthur Rivers, infesting a total of 167,000 acres in 1975. Spruce beetle populations on the Kenai Peninsula remaintained at low levels.

Over 2.5 million acres of paper birch in interior Alaska were visibly defoliated by the spear-marked black moth in 1975, the second consecutive year of widespread defoliation by this insect. Aphid damage to paper birch was also detected in the Matanuska Valley and in the cities of Anchorage and Palmer. An unidentified lepidopterous defoliator caused browning of tamarack in areas along the Tanana River. The western black-headed budworm was responsible for only 5,400 acres of visible hemlock defoliation in southeastern Alaska in 1975, down significantly from 1974.

The eastern larch beetle in interior Alaska north of Mt. McKinley National Park continued to cause scattered tamarack mortality over an area of approximately 350,000 acres.

Tree diseases of interest in southeast Alaska were hemlock dwarf mistletoe, Sirococcus shoot blight on Sitka spruce and western hemlock, western gall rust on lodgepole pine, winter drying of lodgepole pine, and air pollution damage to conifers near the pulp mills in Sitka and Ketchikan.

Local interest was aroused near Fairbanks by herbicide damage to trees along powerline rights-of-way. Locations of significant insect and disease outbreaks are shown on the index map of Alaska (fig. 1).

Status of Insects

Spruce beetle, *Dendroctonus rufipennis* (Kby.). Large spruce beetle populations have infested nearly 167,000 acres on the west side of Cook Inlet, including a small infested area near Katchin Creek at the southern portion of Redoubt Bay; a larger infested area near Kustatan Ridge, Blacksand Creek, and the McArthur and Chakachatna Rivers; and the largest infested area, which surrounds Beluga Lake, Lower Beluga Lake, and a portion of the Beluga River.

Beetle populations in the area of the original infestation near Tyonek were considered inactive, although scattered spruce mortality occurred in several small isolated areas. Activity increased considerably in the area between Lone Ridge and Denslow Lake, where stand depletion had been lower. Although beetle activity was higher north of this area, it was often scattered because of interspersion of muskeg throughout the spruce type. Although tree mortality and resultant stand depletion can occur rapidly in high-density stands containing large susceptible spruce, the infestation in this area seemed to be lingering in scattered patches of timber. Population levels are expected to decline in this area in 1976, but scattered tree mortality is expected to continue.

The northernmost portion of the infestation in the vicinity of Beluga and Lower Beluga Lakes appeared to be losing momentum, but it is difficult to predict what will happen because

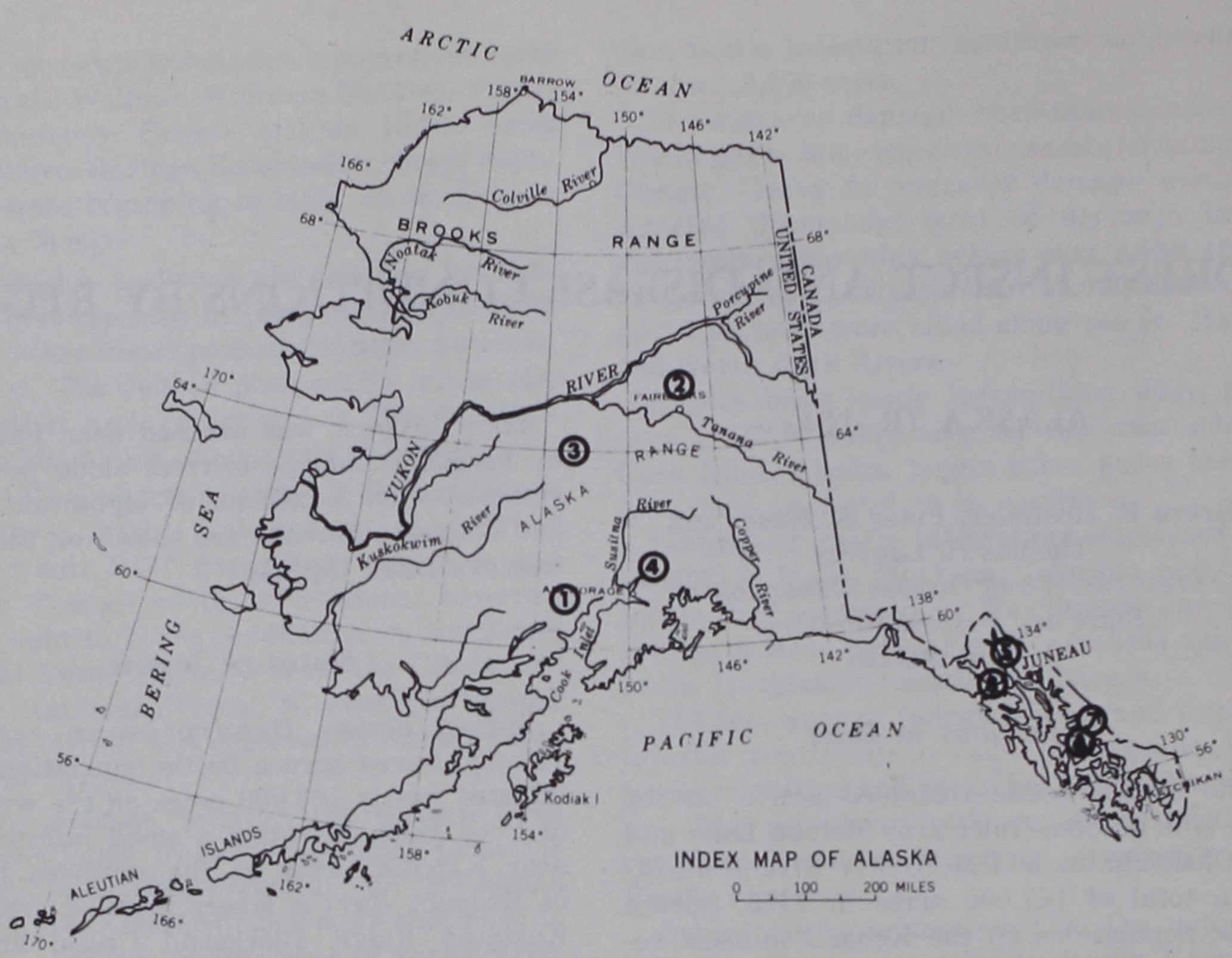

Figure 1.—Locations of some forest insects and diseases in Alaska in 1975: *1*, Spruce beetle; *2*, spear-marked black moth; *3*, eastern larch beetle; *4*, aphids; *5*, western black-headed budworm; *6*, hemlock dwarf mistletoe; *7*, *Sirococcus* shoot blight; *8*, western gall rust and winter drying.

this area lacks large, densely stocked stands of spruce characteristic of the area of initial infestation. Lingering infestation with scattered mortality could develop in areas to the South. New windthrown material with high brood densities detected in the northern portions of the infestation could also lead to an increase in tree mortality.

Stands in the upper Straight Creek and Chakachatna River drainages exhibited heavy mortality in 1975 as the infestation moved to the limits of the spruce type. Areas adjacent to these drainages where heavy stand depletion had already occurred suffered only scattered attacks. Spruce beetle activity is expected to decline in these drainages in 1976.

Spruce stands along the McArthur River and in the vicinity of Blacksand Creek also experienced an increase in beetle activity during 1975. These river bottom stands, where 1974 mortality had been low, experienced heavy infestations and high mortality. Continued mortality is predicted if spruce beetle populations continue to move into stands south of Blacksand Creek toward Kustatan Ridge.

Although the feasibility of controlling large spruce beetle outbreaks by removal and utilization of the infested material was very limited, much of the dead material near Tyonek was being utilized through the Westside Salvage Timber Sale, administered by the Alaska State Division of Lands, Forestry Section. Of the estimated 425 million board feet (MMBF) of timber included in the sale, 8.8 MMBF of white spruce had been cut, decked, and sold by December 1975. An additional estimated 25 MMBF of white spruce and 20 MMBF of hardwood had been cut.

Spruce beetle populations on the Kenai Peninsula subsided in 1974 and remained at low levels in 1975. Small isolated infestations were scattered in areas with little previous spruce mortality. Although no current widespread mortality was detected, surveillance of these areas will be continued in 1976. Of 980 thousand board feet (MBF) of spruce sold north of Kenai, an estimated 60 percent involved salvage of beetle-killed trees. The volume represents 435 acres of State land. On the nearby Kenai National Moose Range, 72 MBF of beetle-killed spruce on 80 acres were included in sales.

Spear-marked black moth, *Rheumaptera hastata* (L.). Nearly 2.7 million acres of paper birch in areas along the Tanana and Yukon Rivers in interior Alaska and along the Susitna River in south-central Alaska were visibly defoliated by the spear-marked black moth. This was more than double the area defoliated in 1974.

In interior Alaska, defoliation of birch decreased west of Tanana and increased in the area between Big Delta and Tok Junction. A fifteenfold increase in defoliation occurred in south-central Alaska near Talkeetna on the Susitna River and extended from Kashwitna northward almost to Curry.

Trees that were heavily defoliated in 1974 appeared to have some twig dieback in 1975. Studies were being planned in cooperation with researchers of the Institute of Northern Forestry (INF) to determine the effects of defoliation on radial growth of birch.

A fall pupal survey conducted in cooperation with INF indicated a general decrease in overwintering populations when compared to results of the 1974 survey. Pupae collected showed a high percentage of parasitization.

Spear-marked black moth defoliation in most areas is expected to decrease in 1976, but the infestation centered near Talkeetna, which is newer, may show a population increase next year.

Eastern larch beetle, *Dendroctonus simplex* LeC. Scattered tamarack mortality covered about 350,000 acres, as compared to 130,000 acres in 1974. The area affected was bounded by Minchumina and Chilchukabena Lakes on the north and Mt. McKinley National Park on the south, and extended from the Foraker

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Figure 2.—Beetle-killed tamerack showing adult *Dendroctonus simplex* exit holes and phloem macerated by larvae (Alaska).

River on the west across the McKinley River to Moose Creek on the east. Dead and yellowing tamarack were scattered throughout the area (fig. 2) ; somewhat higher mortality and damage occurred adjacent to streams.

Dying trees were detected aerially by their yellowing crowns in July and August. Biological evaluations conducted in conjunction with the Intermountain Forest and Range Experiment Station, Moscow, Idaho, indicated that tamarack attacked in late spring or early summer would show yellowing and may die during the same year.

Western black-headed budworm, *Acleris gloverana* (Wlshm.). In the southeast Alaska annual larval survey, conducted in cooperation with the Forestry Sciences Laboratory, Juneau, larval counts from permanent sample points indicated that budworm populations decreased markedly from the already low levels of the previous year. Only one sampling point, Hood

Bay, showed a significant increase. All points with high counts in 1974 produced fewer larvae in 1975.

A significant decrease in budworm-caused hemlock defoliation was observed in southeast Alaska; 5,400 acres were defoliated in 1975, compared to 11,400 acres in 1974. The only defoliation detected from the air was located on Lincoln and Sullivan Islands in Lynn Canal northwest of Juneau. No new defoliation was spotted in areas that exhibited medium to heavy defoliation in 1974.

This general population decline was partly attributed to cool summer temperatures along with a probable increase in numbers of parasitoids and incidence of diseases.

Although localized infestations in high-value areas that may require suppression were not predictable, past histories indicate that such infestations may occur. As in 1974, therefore, several thousand budworm larvae were sent to the Forest Service Insecticide Evaluation Project, Berkeley, Calif., where efficacy of several insecticides was determined in laboratory bioassays.

Early November egg sampling showed very few eggs present in the Ward Creek drainage near Ketchikan. Because of this and the fact that 1975 populations were generally small throughout southeast Alaska, 1976 populations are expected to be at insignificant levels in most areas.

Hemlock sawfly, *Neodiprion tsugae* Midd. Results of the southeast Alaska annual larval survey, conducted in August, indicated that hemlock sawfly populations declined as expected. Sawfly larvae were found at 13 of the 97 points sampled with a range of 1 to 75 larvae per three-tree beating sample. All 13 points at which larvae were found were located south of Frederick Sound. Hemlock sawfly populations have declined since the occurrence of the relatively high population densities in 1972. As in 1974, no hemlock defoliation was detected on aerial surveys that covered much of the Tongass National Forest.

In the Ward Creek drainage near Ketchikan, early November observations indicated that overwintering egg population densities were low, even in areas which showed evidence of 1975 larval feeding. Since October weather seemed to be favorable for oviposition, low egg numbers occurred because of larval and pupal mortality caused by fungal diseases and parasitoids.

Even though fewer eggs were found near Ward Creek, favorable weather conditions during the oviposition periods could result in noticeable 1976 defoliation in other localized areas south of Frederick Sound.

Geometrid moth or looper, *Operophtera hyperboreata* (Hulst). This pest caused very little defoliation of deciduous trees and shrubs on Kodiak Island in 1975. Unlike the previous 3 years, no adult moths were seen in flight in early fall, indicating that the populations had collapsed.

Mortality of willow, birch, and cottonwood was reported by an aerial survey of part of Kodiak Island. Mortality was most noticeable on Amook Island and in areas near Karluk Lake and Zachar Bay. Death was probably due to 3 consecutive years (1972 through 1974) of heavy defoliation by *O. hyperboreata* larvae.

Aphids. Aphids, possibly composed of several species, were observed in large numbers on paper birch in the mixed hardwood and spruce-hardwood stands near Palmer as in 1974. Over 460,000 acres of birch discoloration were detectable from the air. The infested area, which has more than doubled since 1974, followed the Matanuska Valley, with the limits of browning being Big and Nancy Lakes on the west and Gunsight Mountain on the east.

Cedar bark beetle, *Phloeosinus* sp. Dead cedar in small pockets of several trees each on Kupreanof and Mitkof Islands aroused some interest in 1975. Ground checks showed that some of the dead or dying cedar had been or were infested with bark beetles of the genus *Phloeosinus*. As a rule, beetles of this genus attack trees that are weakened or dying, but occasionally they will attack and kill apparently healthy trees. Closer observations of these beetle-infested cedar is planned for the 1976 field season.

Other insects. During late spring and/or early summer, a small unidentified lepidopterous defoliator caused browning of scattered tamarack stands along the Tanana River from Fairbanks to Delta Junction. An aerial survey made in cooperation with INF showed that the most severe browning occurred in the Shaw Creek Flats area. Ground investigations on June 20 revealed that the insects were in

pupal stage and that the percentage of parasitization was high. Rearing attempts for identification purposes were unsuccessful. These insect populations will be monitored in 1976.

Status of Diseases

Hemlock dwarf mistletoe, *Arceuthobium tsugensis* (Rosend.) G. N. Jones. Hemlock dwarf mistletoe continued to occur in areas of southeast Alaska. Mistletoe control work was completed on 1,900 acres in the Stikine Area of the Tongass National Forest during fiscal year 1975, and contracts were let for 1,600 acres in fiscal year 1976. The control work consisted of removing residual western hemlock from logged areas infected by dwarf mistletoe.

Sirococcus shoot blight, *Sirococcus strobilinus* (Desm.) Petrak. *Sirococcus* remained active on Sitka spruce and western hemlock at Thomas Bay. Sitka spruce was lightly attacked with little apparent damage, but western hemlock was heavily attacked, particularly along old skid trails and logging roads. It is not known as yet what effect 1975 precommercial thinning will have on the incidence of the disease. Hemlock reproduction in the 13-year-old clearcut at Lemon Creek near Juneau was lightly affected by *Sirococcus* in 1975.

Spruce needle rust, *Chrysomyxa ledicola* (Pk.) Lagerh. The incidence of needle rust on Sitka spruce was at a low level this year. Only a few infected trees scattered through southeast Alaska were observed. As a result, little local interest was aroused and fewer than usual requests for information about the disease were received.

Western gall rust, *Endocronartium harknessii* (J. P. Moore) Y. Hiratsuka. Lodgepole pine at Gustavus was severely damaged by western gall rust. Trees of all age and size were damaged or killed. The breaking up of the lodgepole stand by the rust is accelerating the conversion to a Sitka spruce-western hemlock stand.

Spruce broom rust, *Chrysomyxa arctostaphyli* Diet. A few rust brooms on Sitka spruce were found near the Glacier Bay Lodge at Gustavus. This rust, although uncommon in southeast Alaska, was one of the most noticeable pathogens on black spruce and white spruce in interior Alaska.

Cytospora canker, *Cytospora chrysoperma* (Pers.) Fr. An aspen stand near Fairbanks previously damaged by a light ground fire was further damaged by cankers. Extensive bole deformation and tree mortality occurred.

Winter drying. Some lodgepole pine at Gustavus suffered extensive winter drying damage this past winter. This winter drying, combined with western gall rust, caused significant losses in the stand.

Undetermined hemlock mortality. An unidentified disease continued to cause hemlock mortality at Edna Bay on Kosciusko Island. Most of the mortality appeared to be along logging roads, but scattered trees within the stand also exhibited the disease symptoms. Trees of all ages showed the disease symptoms, which consisted of necrosis of the crown beginning in the lowermost branches and progressing upward.

Bark necrosis on white spruce. White spruce located near timberline on Mount Yenlo, southwest of Talkeetna, began to slough off dried patches of bark 10 to 15 centimeters (4 to 6 inches) in width and about 75 centimeters (30 inches) in length. The patches were not oriented in any particular direction, and all were below the winter snow line. The causal agent was not identified.

Air pollution and herbicide damage. Conifer damage and mortality due to air pollution continued in the vicinity of the pulp mills at Sitka and Ketchikan. Picloram and dicamba applied along powerline rights-of-way at Fairbanks in the fall of 1974 caused considerable damage to nontarget trees on adjoining land. The herbicides were applied after the ground was frozen and were carried for considerable distances beyond the rights-of-way when spring runoff occurred. In many instances, surface drainage patterns were clearly delineated by injured and dying trees. White and black spruce, birch, aspen willow, and other brush species were affected.

OREGON AND WASHINGTON
(R–6)

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Conditions in Brief

Western spruce budworm infestations intensied in Douglas-fir and true fir stands on portions of the Okanogan and Wenatchee National Forests and on the North Cascades National Park in north-central Washington. In Oregon, outbreaks on the Wallowa-Whitman National Forest and on the Warm Springs Indian Reservation increased in both size and intensity.

Modoc budworm populations, which declined significantly in 1975, caused light defoliation in the Warner and Gearhart Mountains on the Fremont National Forest.

Larch casebearer activity was at about the same level as last year in both States, but new populations were detected in the Washington Cascades in the vicinity of Swauk Pass southwest of Wenatchee.

No Douglas-fir tussock moth defoliation was recorded in either State.

Balsam woolly aphid damage, which was observed in both States, was found in a new center, the Mt. Baker-Snoqualmie National Forest, in the vicinity of Concrete, Washington, indicating a northern extension of this pest. No visible damage was observed in the Blue Mountains, where the insect was discovered in 1974.

Bark beetle activity increased in both Oregon and Washington in 1975. The mountain pine beetle continued to cause heavy mortality in lodgepole pine stands in eastern Oregon, with the largest outbreak encompassing approximately 920,000 acres on the Umatilla, Wallowa-Whitman, and Malheur National Forests. The area of fir engraver damage more than doubled in Washington and increased nearly fivefold in Oregon. Douglas-fir beetle losses more than doubled in the eastern portion of both States, but the outbreak on the Gifford Pinchot National Forest near Packwood, Wash., was effectively controlled by helicopter salvage logging. Western pine beetle activity more than doubled in both States. A flatheaded fir borer outbreak triggered by drought conditions in southern Oregon in 1974 also increased significantly this year.

The incidence of foliage diseases and weather injuries continued to cause damage in both forest nurseries and forest stands in 1975. Mortality of seedlings caused by *Phytophthora* fungi was observed in several forest nurseries in both Oregon and Washington. Several rust fungi that infect foliage were common on true firs and hemlock, and damage caused by Rhabdocline needle cast affected Douglas-fir in several Christmas tree plantations in western Oregon.

Root rots, heart rots, and dwarf mistletoe continued to be the most important diseases in the Pacific Northwest.

Status of Insects

Western spruce budworm, *Choristoneura occidentalis* Freeman. The total number of acres defoliated by the western spruce budworm remained about the same as last year. Approximately 532,000 acres of Douglas-fir and true firs were defoliated to some extent this year. The majority of the damage occurred on the Okanogan and Wenatchee National Forests and in the North Cascades National Park in north-central Washington. Scattered light to moderate defoliation totaling about 8,400 acres occurred on the Wallowa-Whitman National Forest in northeastern Oregon, and light to heavy defoliation was detected on 10,560 acres on the Warm Springs Indian Reservation on the eastern slopes of the Oregon Cascades south of Mt. Hood.

Aerial and ground surveys indicated that trees in areas continuously defoliated for 3 or more years were beginning to decline in vigor, as evidenced by failure to produce new buds and foliage. Some trees in the older defoliation centers exhibited dead tops, twigs, and branches.

During the spring of 1975, the weather was considerably cooler and wetter than normal and probably had some adverse affect on larval survival. The results of the 1975 fall egg mass survey, however, indicated that populations will be high enough in 1976 to cause light to heavy defoliation in most areas.

With the knowledge obtained from previous

outbreaks, it is reasonable to assume that a continuation of these outbreaks will result in an acceleration of growth loss and top-kill. Direct control, therefore, on nearly 276,000 acres is being planned for 1976 using carbaryl, a carbamate material manufactured under the trade name of Seven® 4 Oil. Although this material is specifically registered for control of the eastern spruce budworm, *Choristoneura fumiferana* (Clem.), the manufacturer has applied for registration of the material for control of the western spruce budworm. If approved, the material will be applied in a single application at a rate of 1.0 pound active ingredient in 64 ounces of oil per acres.

The objectives of this proposed action will be to reduce budworm populations significantly enough to prevent an acceleration of growth loss and top-kill, restore tree vigor, reduce the threat of extensive loss of reproduction, prevent serious impairment of the esthetic and recreational values of these areas, and restore the production of cone and tree seed in the defoliated areas.

Modoc budworm, *Choristoneura viridis* Free. Damage caused by this insect declined significantly in 1975. Light defoliation over approximately 28,450 acres occurred in localized areas in the Warner and Gearhart Mountains on the Fremont National Forest in southeastern Oregon. Although the cause of population decline was not known, it may have been partly related to the cool, damp spring, the early summer weather, and the occurrence of a severe frost in late July. The results of an egg mass survey indicated that populations will be at a low level in 1976.

Larch casebearer, *Coleophora laricella* (Hbn.). Population densities remained at low levels in western larch stands of eastern Washington and northeast Oregon.

An aerial survey conducted in early June revealed fewer than 7,000 acres of visible defoliation in northeastern Oregon and Washington. The largest single area of defoliation, totaling nearly 6,500 acres, occurred on the Umatilla National Forest between Fry Meadow and Mosier Spring, southwest of Troy, Oreg.

A new infestation was observed on the ground at Swauk Pass in the Washington Cascades southwest of Wenatchee. Population densities, however, were not sufficient to cause defoliation visible from the air. This find represents a southern extension into the Washington Cascades by nearly 86 air miles; previously, the pest had never been found south of Loup Loup Pass on the Okanogan National Forest.

In 1975, the Boise Cascade Corporation released several different parasites in northeastern Oregon. These included species of *Agathis, Chrysocharis, Elachertus,* and *Necremnus.* This release was part of an Intermountain Forest and Range Experiment Station research study of the biological control of this introduced forest pest.

Douglas-fir tussock moth, *Orgyia pseudotsugata* McD. No defoliation by this insect was observed in either Oregon or Washington, but individual larvae were recovered from 9 of 358 defoliator monitoring plots located in eastern Oregon and Washington: one plot each on the Deschutes and Mt. Hood National Forests, two plots on the Fremont National Forest, three plots on the Winema National Forest, Oreg.; and one plot each on the Colville and Wenatchee National Forests, Wash.

Low population levels were found for the fifth consecutive year at Mare's Egg Spring on the northwest side of upper Klamath Lake on the Winema Natic Forest. The trend of this infestation was not known, but low population densities are again expected in this area in 1976.

Balsam woolly aphid, *Adelges piceae* (Ratz.). Damage caused by this insect continued to be observed in the true fir stands of western Oregon and Washington. A new center of damage in subalpine fir was recorded on the Mt. Baker-Snoqualmie National Forest in the vicinity of Concrete, Wash. This find represented a northern extension of its range; previously, this pest had never been found north of the Snoqualmie River.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. This insect continued to cause extensive mortality in lodgepole pine stands in eastern Oregon. An estimated 181 MMBF on 1,107,520 acres of lodgepole pine were killed this year. Of this amount, nearly 84 percent of the volume occurred on the Malheur, Umatilla, and Wallowa-Whitman National Forests. Since this outbreak began in 1969, it is estimated that 595.1 MMBF of mature

lodgepole pine have been killed. Although populations within the oldest portions of this outbreak were declining, it is anticipated that tree mortality will continue to occur in 1976 in the remaining portions.

Mountain pine beetle losses in western white pine stands remained low throughout the mountainous regions of both States. In Oregon, the heaviest tree killing occurred on the Willamette National Forest; in Washington, it occurred on the Mt. Baker-Snoqualmie, Okanogan, and Wenatchee National Forests.

Mountain pine beetle attacks in second-growth ponderosa pine stands increased nearly fourfold in Oregon, but remained nearly the same as last year in Washington. The heaviest damage in Oregon occurred in the Grande Ronde River drainage near La Grande, in the Powder River drainage in the vicinity of Sumpter, in the vicinity of Dooley Mountain south of Baker, and in the Wallowa Mountains southeast of Elgin.

Fir engraver, *Scolytus ventralis* Lec. Fir engraver activity increased throughout Oregon and Washington this past year, and all eastside forests suffered some damage. Particularly heavy losses occurred on the Malheur, Ochoco, Umatilla, and Wallowa-Whitman National Forests, Oreg., and on the Umatilla and Okanogan National Forests, Wash.

This increase in fir engraver activity was believed to be associated with drought conditions that occurred throughout most of eastern Oregon and Washington in 1973 and 1974. Research findings indicate that significant increases in fir engraver activity in white fir stands often follow periods of subnormal precipitation. The greatest amount of mortality and top-kill generally occurred in overstocked pole and small sawtimber size stands occupying the poorer growing sites, or in mature to overmature stands that were heavily infested with mistletoe. The trend of these outbreaks is not known, but it has been observed that fir engraver outbreaks usually subside rapidly during periods of normal moisture conditions.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. This insect killed an estimated 14.7 MMBF of Douglas-fir in Oregon and Washington in 1975. The largest outbreaks were observed on the Wallowa-Whitman and Umatilla National Forests, Oreg., and on the Okanogan and Mt. Baker-Snoqualmie National Forests, Wash.

The severe 1974–75 infestation on the Gifford Pinchot National Forest near Packwood, Wash., was successfully terminated by helicopter logging. A total of 101 MMBF of timber, including an estimated 71.5 MMBF of beetle-infested trees, was removed. The additional 29.5 MMBF of noninfested trees were logged to meet silvicultural requirements. Almost all the infested trees were removed before May 1, 1975, when the beetles would have emerged to attack more green trees.

During the 1975 aerial survey, Douglas-fir beetle activity was not observed in the tussock moth outbreak areas of 1972–74 in northeastern Oregon and southeastern Washington. Field surveillance, however, indicated that beetle activity was increasing in these tussock moth areas, and the infested trees that start to fade in the winter will be easily detected during the 1976 aerial survey. Many of the infested trees were currently being logged in the process of salvaging the trees killed by the tussock moth.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). Spruce beetle activity increased throughout eastern Oregon and Washington. The heaviest damage occurred on the Wallowa-Whitman and Umatilla National Forests in Oregon. The trend of these outbreaks is unknown.

Western pine beetle, *Dendroctonus brevicomis* LeC. Western pine beetle infestations increased throughout Oregon and Washington. In Oregon, nearly 11.9 MMBF were killed on the Fremont, Ochoco, Malheur, Deschutes, and Winema National Forests. The heaviest losses occurred in Washington on the Yakima Indian Reservation.

Flatheaded fir borer, *Melanophila drummondi* (Kirby). Infestations continued on low-site forest lands in southwestern Oregon between Roseburg and the Oregon-California State line. Most of the tree killing, on approximately 140,000 acres, occurred on dry rocky sites located along the foothills of the Rogue and Umpqua Rivers drainages in the vicinity of Riddle, Grants Pass, Medford, and Ashland. The continuation of this outbreak was attributed largely to the severe drought conditions that occurred in 1973 and 1974.

Evaluation results by Oregon State Depart-

ment of Forestry entomologists indicated that populations were declining, probably because of the increased precipitation that occurred during the 1975 growing season. This downward trend is expected to continue in 1976.

Other insects. Oregon State Department of Agriculture Report Surveys (in which pheromone traps were used in commercial nurseries and on ornamental plantings of pines in the Willamette Valley) recovered European pine shoot moth larvae, *Rhyacionia buoliana* (Schiff.), from two new infestation sites: a field nursery in Clackamas County and a senior citizens' housing project located near Woodburn, Marion County.

The results of cooperative State and Federal detection surveys for the gypsy moth, *Lymantria dispar* (L.), in parks and highway rest stops in western Oregon and Washington were negative. The larch sawfly, *Pristiphora erichsonii* (Wong and Ross), caused light defoliation on about 600 acres of western larch in the upper portion of Fifteen Mile drainage near Bulo Point on the Barlow Ranger District, Mt. Hood National Forest. The trend of this outbreak is not known, but parasites and predators were expected to reduce populations before serious tree damage occurred.

The spruce needle miner, *Taniva albolineana* (Krft.), caused moderate damage on older needles of ornamental Colorado blue spruce in Wenatchee, Washington. An unidentified species of eurytomid wasp, *Eurytoma sp.*, was found infesting boles and branches of a number of ponderosa pine trees in a 12-year-old plantation near Butte Falls, Oreg., on the Rogue River National Forest.

The gouty pitch midge, *Retinodiplosis inopsis* (O.S.), was observed in the vicinity of Howard Bay (upper Klamath Lake), 9 miles northwest of Klamath Falls, causing heavy damage to 1,190 acres of ponderosa pine. The damage consisted of bud and needle mortality on 1975 shoots and occurred in stands of second-growth ponderosa pine less than 30 feet tall. The variegated cutworm, *Peridrema saucia* (Hbn.), caused significant damage in the Wind River Nursery on the Gifford National Forest.

The Oregon State Department of Agriculture reported numerous smaller European elm bark beetles, *Scolytus multistriatus* (Mrsh.), caught in pheromone traps throughout Oregon. These insects were also reported on firewood and standing American elm trees for the first time in 2 years in Union County, Oreg. Dutch elm disease, *Ceratocystis ulmi* (Burs.) C. Moreau, cultured from a tree in Union County in 1974, substantiated the presence of the disease in the State.

Scattered top-kill of drought-weakened Douglas-fir by the Douglas-fir engraver, *Scolytus unispinosus* Lec., continued on the Mt. Hood National Forest; additional new top-kill was observed on the Wallowa-Whitman National Forest. No damage was observed in Washington. Results of an Oregon Department of Agriculture survey report showed that 50 percent of the ornamental birch trees in Enterprise, Wallowa County, Oreg., were infested with the bronze birch borer, *Agrilus anxius* Gory. Damage caused by the insect was usually most severe during or immediately following periods of drought.

The Oregon pine ips, *Ips pini* (Say), which had been declining since 1974, infested second-growth ponderosa pine and caused approximately 13,000 acres of mortality. Infestations in Oregon accounted for 96 percent of the losses, with nearly 90 percent of the mortality occurring on the Wallowa-Whitman National Forest. Tree killing in Washington, amounting to 550 acres, occurred on the Okanogan National Forest and on private lands in the vicinity of Spokane.

Scattered infestations of Douglas-fir twig weevil, *Cylindrocopturus furnissi* Buch., were found in Douglas-fir plantations throughout southwestern Oregon. Outbreaks were observed primarily in areas with compacted soils, on old burns, and on dry sites, particularly gravel soils. These outbreaks, considered to be a result of the 1973–74 drought that occurred in this area, were expected to subside with a return to normal moisture conditions.

Spider mite, *Oligonchus ununquis* (Jacob.), caused light defoliation to Douglas-fir on 640 acres of the Malheur National Forest, on 2,490 acres of the Wallowa-Whitman National Forest, Oreg., and 250 acres of the Colville Indian Reservation, Wash.

Much of the defoliation on the Colville Indian Reservation and a small portion of the defoliation on the Wallowa-Whitman National Forest occurred in areas previously treated with DDT

for control of the Douglas-fir tussock moth in 1974. The majority of the damage, however, occurred in areas that had not been treated. The cause of mite activity in areas not treated with DDT was not known, but it may have been partly related to the occurrence of an unusually hot, dry summer, a condition that favors spider mite outbreaks. These outbreaks, however, are expected to collapse by 1976 as the biological balance with natural predators reaches an equilibrium. No serious damage is expected.

Status of Diseases

Phytophthora root rot of Douglas-fir seedlings. Four species of *Phytophthora* fungi have been isolated from root-rotted and dead Douglas-fir seedlings in several forest nurseries in Oregon and Washington. The four species were tentatively identified as *P. cinnamomi, P. dreschleri, P. cryptogea,* and an unidentified species. With the exception of *P. cinnamomi,* the Phytophthoras have not previously been reported on Douglas-fir or on other northwest conifers. All of these fungi have not been demonstrated to be pathogenic to Douglas-fir seedlings in small-scale plot tests.

Mortality of seedlings in the infested nurseries occurred in very wet portions of seed beds where water tended to remain on the surface. Disease incidence was absent or very limited in well-drained portions of the infested nurseries. Survival of stock outplanted from an area known to be infested in one nursery was poor.

Drought injury. The prolonged dry fall of 1974, which extended well into November, contributed to widespread tree killing, top-kill, and branch flagging on Douglas-fir in southern Oregon and scattered locations throughout Oregon and Washington. In a few cases, damage became apparent in November and December 1974, but symptom expression on most trees was delayed until the spring of 1975. Damage was particularly noticeable in the Illinois Valley around Cave Junction. The moist conditions of 1975 helped to relieve much of the drought stress.

Elytroderma needle blight. Elytroderma needle blight, caused by *Elytroderma deformans,* became quite noticeable throughout much of eastern Oregon in 1975. Ponderosa pine stands in the Ochoco Mountains and portions of the Blue Mountains displayed the most damage; these were the same areas that were severely damaged by an outbreak in the late 1940's. Damage in 1975, however, was not severe enough to cause tree killing. The amount of visible damage is expected to increase significantly in 1976 because of the large infection centers which existed in 1975.

Rhabdocline needle cast of Douglas-fir. Rhabdocline needle cast caused by *Rhabdocline pseudotsugae* damaged Christmas tree plantations in Clackamas County this spring, but no increase in infection was evident in forest stands.

The cool, moist spring, summer, and fall weather contributed to an increase in foliage infections by several rust fungi. *Puccinia geoppertianum, Chrysomyxa ledicola,* and *Melampsora abietis-canadensis* were common on true firs and hemlocks this year.

Decay, root rot, and dwarf mistletoe. The most important forest diseases in Oregon and Washington were decay, root rot, and dwarf mistletoe. These diseases take a large yearly toll but are not subject to yearly fluctuations.

The number of forest stands known to be infected by laminated root rot caused by *Phellinus weirri* continued to increase, largely as a result of increased awareness of the disease by many foresters. Several infection centers were detected in stands in eastern Oregon and Washington; infection centers were also detected in southern Oregon in 1975.

Decay continued to cause large losses in northwest forests. This serious problem is not going to disappear as the old-growth stands are removed, because wounds on young trees provide ideal infection courts for decay-causing organisms. This problem was especially acute in western hemlock trees wounded by logging or bears.

Dutch elm disease, *Ceratocystis ulmi* (Buism) C. Mor. Although this disease had previously been detected in Ontario, Nyssa, and Union, Oreg., it was not reported in any new locations in 1975.

CALIFORNIA AND HAWAII (R–5)

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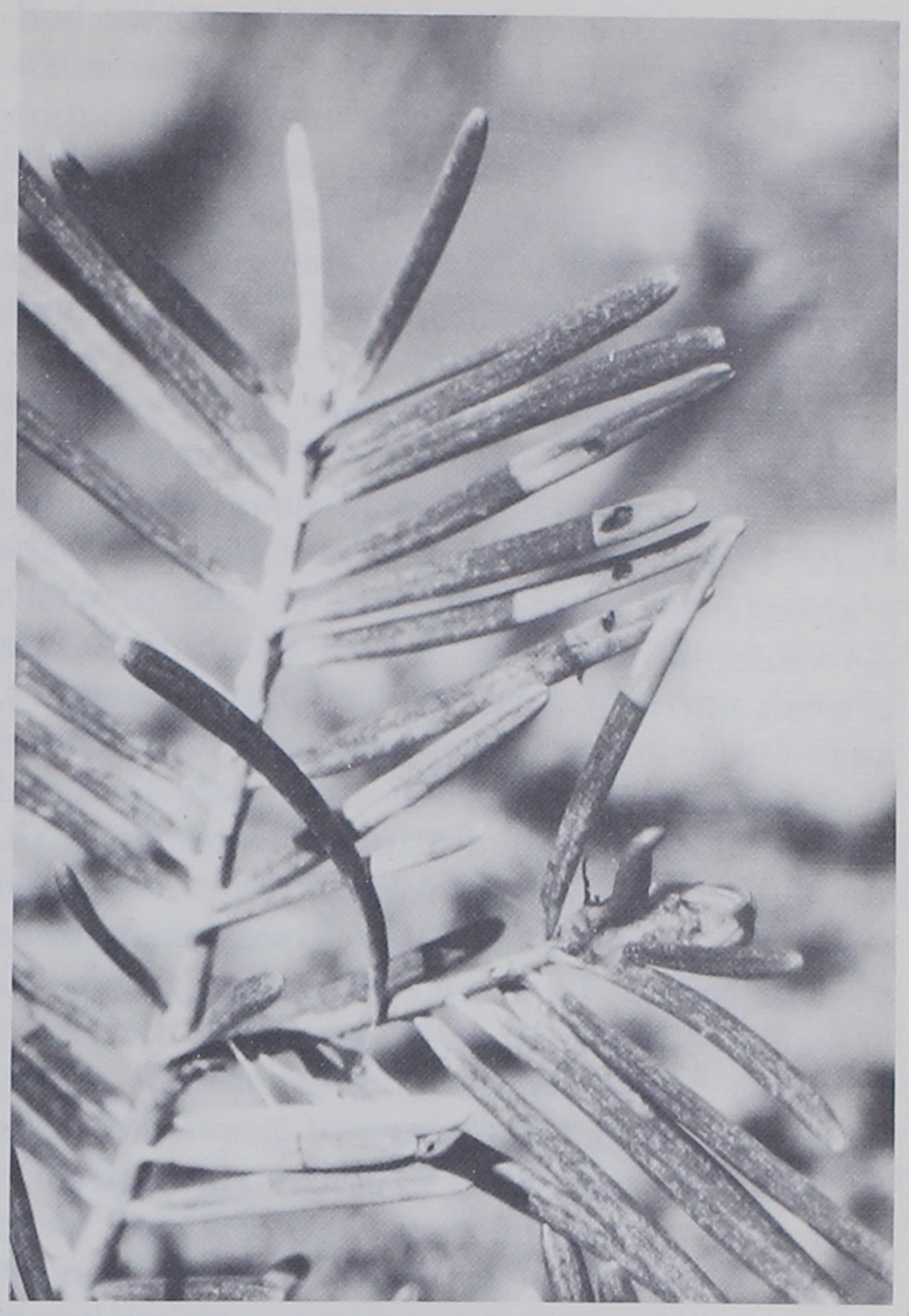
Conditions in Brief

The large Modoc budworm infestation, first reported in 1973, declined in 1975 as expected. Several other forest insect pests, however, enlarged or intensified their infestations. The white fir sawfly caused conspicuous defoliation in some 70 centers, and white fir needle miner severely defoliated trees around Manzanita Mountain on the Modoc National Forest. The Jeffrey pine needle miner enlarged its area of activity in southern California.

Bark beetles and cambium borers tended to be more aggressive in 1975. Outbreaks of the flatheaded fir borer, western pine beetle, and mountain pine beetle were the most notable examples.

A foliage disease killed 4 million Douglas-fir seedlings in the Humboldt Nursery; above-normal precipitation during the winter of 1974–75 pervented the application of fungicides for control. A branch and stemcanker contributed to the death of many Douglas-fir in the northwestern part of the state; another canker caused widespread decline of white fir in northeastern California. Damage to pines caused by smog continued to increase in southern California and Sierra Nevada forests. Dutch elm disease was discovered for the first time in California in Sonoma, Napa, and Santa Clara Counties.

A native cerambycid beetle specific to ohia is one of several factors associated with the decline of the ohia forests on the island of Hawaii. Black twig borers were heavily infesting a forest weed, *Clidemia hirta*. This infestation is under surveillance because the twig borers could also attack native and exotic forest trees. The Eurasian pine aphid continued to spread in pine stands on the island of Maui. The annual buildup of the acacia psyllid on koa was evident again during March through June.



F–523676

Figure 3.–Damage to white fir needles caused by the white fir needle miner, *Epinotia meritana* (California).

Ohia forest decline remained the most destructive disease problem in Hawaii. Intensive research is being conducted to determine the cause and possible control methods for the decline. Needle cast disease is still a problem in pine stands on the island of Molokai. Additional needle cast infestations were detected on young pine plantings on the island of Kauai.

Status of Insects—California

Budworms, *Choristoneura* spp. Populations of budworms in the Modoc National Forest infestation–including the Modoc budworm (*C. viridis* Freeman) on white fir, and the sugar pine tortrix (*C. lambertianae* Busch) on pine–declined sharply, as expected. Only light defoliation was detected from the air on 12,800 acres of white fir and on 6,400 acres of pine, down from 143,000 and 17,000 acres, respectively, in 1974.

White-fir needle miner, *Epinotia meritana* Hein. The white fir needle miner was one of

several insects associated with the Modoc budworm on white fir and was the only species involved whose populations increased significantly in the infested area in 1975. Some 8,000 acres of white fir previously damaged by the budworm lost much of their remaining foliage to needle miner feeding (fig. 3.), and some tree mortality is expected.

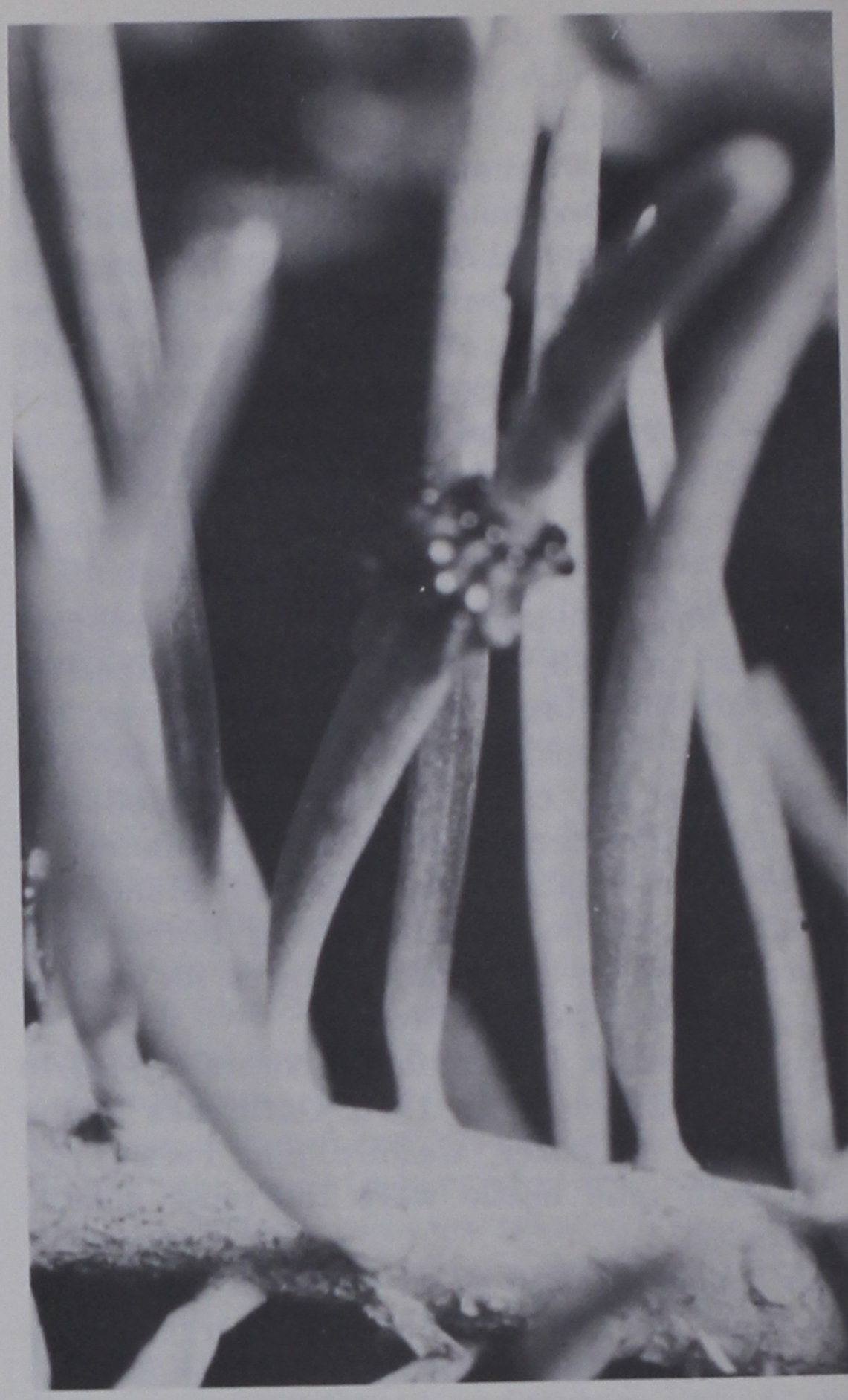
Lodgepole pine needle miner, *Coleotechnites milleri* (Busch). Populations of this persistent pest were again high in Yosemite National Park. Population estimates in 1975 rose to the highest level since the peak of the previous epidemic in 1961. Extensive defoliation was present north and east of Tuolumne Meadows, and a previously undetected infestation was reported from Big Arroyo in Sequoia National Park and from Kings Canyon National Park. While trees in campgrounds and developed areas were not immediately threatened, trees died in remote Lyell and Virginia Canyons as a result of the current epidemic.

White fir sawfly, *Neodiprion abietis* (Harris). Outbreaks of the white fir sawfly (fig. 4) have been unusually prevalent in California fir forests in recent years. Since 1969, many locations defoliated by the pest have been reported, and several infestations were examined by entomologists. Damage in these infestations usually subsided after 1 year of defoliation, but in some cases, the infestation persisted in the same location for 2 or more years.

Defoliation was widespread in 1971 and 1972, and in 1975, some 70 infestation centers totalling about 40,000 acres were mapped by aerial reconnaissance. The largest and most numerous infestations were found on Pilot Peak, Plumas National Forest, and on French Meadow Reservoir, Tahoe National Forest. Defoliation was mapped as far south as the Tuolumne River.

Douglas-fir tussock moth, *Orgyia pseudotsugata* McD. Douglas-fir tussock moth populations have remained at low levels since the last outbreak of 1970–73. The pheromone of this moth has been synthesized, and the California Region of the Forest Service initiated a tussock moth trapping program as part of a westwide effort to monitor populations of this important forest pest (the expanded USDA Research and Development Program for Douglas-fir Tussock Moth).

In 1975, pheromone traps were deployed in



F–523677

Figure 4.–White fir sawfly. Colonies of white fir sawfly larvae displaying characteristic innate cooperative consumption of white fir needles (California).

105 locations around the State, and moths were found at almost all of the sites. No valid conclusions about population levels could be drawn from this survey, as trapping criteria were yet to be developed, but it was evident that tussock moths were present in nearly all zones suitable to their biology.

Jeffrey pine needle miner, *Coleotechnites* sp. near *milleri* (Busck). A persistent infestation of this needle miner continued to spread in the San Bernardino Mountains of southern California. A 1975 survey recorded 3,270 acres of trees infested, an enlargement of about one-third over the area reported in 1974.

Evaluations of the effects of needle miner attacks continue. The first outcome was that

the impact on tree growth and vigor was less than would be expected from the appearance of the defoliated trees.

Fruit-tree leaf roller, *Archips argyrospilus* (Walker). The fruit tree leaf roller defoliated California black oak stands on some 14,500 acres near Lake Arrowhead in San Bernardino County. This outbreak, which developed over the past 3 years, may have run its course. The massive defoliation and the nuisance of the disagreeable abundance of insects were of great concern to county residents, but no appreciable tree mortality is expected.

Gypsy moth, *Lymantria dispar* (L.). The California Department of Food and Agriculture continued quarantine inspections and pheromone trapping to detect the entry of this pest into California. Nearly 100 entries were detected, and these were usually egg masses on household goods and trailers from infested States. Adult male moths were trapped at Berkeley in 1973 and at Yosemite in 1974. To date, all known importations have been eradicated and no active infestations are known or suspected to exist in the State.

Flatheaded fir borer, *Melanophila drummondi* (Kby.). The flatheaded fir borer was involved in the increasing mortality of Douglas-fir in northwestern California. The condition was first recognized in 1973, became more widespread in 1974, and increased to major proportions in 1975. Dying trees were found most often on poor sites. Although the flatheaded fir borer killed most of these trees, poor growing conditions and a canker disease were believed to have contributed to the condition (see Status of Disease).

Dying trees were scattered over several hundred square miles. The most conspicuous losses occurred in the Salmon River and in the South Fork of the Trinity River regions in the Klamath and Six Rivers National Forests.

Western pine beetle, *Dendroctonus brevicomis* LeC. Reported infestations of the western pine beetle indicated that activity increased in 1975. In some localities the beetles reached high population levels and killed large groups of trees.

The most notable outbreak occurred at Glenburn in Shasta County, where beetle attacks severely reduced ponderosa pine stands. Increased tree killing was evident also in the Hat Creek country south of Glenburn. Some serious tree losses occurred in recreation sites and commercial stands elsewhere.

Silvicultural treatment and salvage logging were used to suppress active infestations in northern California, and silvicultural treatment, salvage logging, and chemical sprays were used in the recreation forests of southern California.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. An outbreak of the mountain pine beetle in lodgepole pine stands, reported in 1974 in the southern Warner Mountains on the Modoc National Forest, continued during 1975. Some 3,400 acres of trees were affected at Skunk Cabbage Creek. Records indicated that another outbreak occurred in this same area between 1955 and 1964. Initial surveys of losses and bark beetle risk in the affected stands suggested that another persistent outbreak might develop.

Jeffrey pine beetle, *Dendroctonus jeffreyi* Hopk. Above-normal activity continued on the Hat Creek and Bogard Districts of Lassen National Forest and at Fallen Leaf Campground near Lake Tahoe.

Fir engraver beetle, *Scolytus ventralis* Lec. Localized infestations were detected in a few localities, and in some cases tree killing was concentrated enough to permit suppression through salvage logging. The most important outbreaks occurred at Franklin Creek and Blue Lake, Modoc National Forest; Goosenest, Klamath National Forest; Squaw Peak, Plumas National Forest; and Piute Mountain, Sequoia National Forest.

Pine engraver beetles, *Ips* spp. A remarkably rapid buildup occurred at the Sugarloaf Picnic Area on the Lassen National Forest, Shasta County; the beetles attacked ponderosa pines damaged by the Cave Fire of July 1975. The infestation was not expected to persist or spread much beyond the fire-damaged trees, as the soil moisture was adequate to maintain the vigor of undamaged trees. Other reports suggested that normal activity prevailed elsewhere in the State.

Scale insects. Several reports were received in 1975, but the incidence and damage of these insects appeared to have diminished greatly from previous years. Important scale infestations included the black pine leaf scale, *Nucu-*

laspis californica (Coleman); the pine needle scale, *Chionaspis pinifoliae* (Fitch); and the sugar pine matsucoccus scale, *Matsucoccus paucicicatrices* Morrison.

Other insects. The western pine shoot moth, *Eucosma sonomana* Keaf., was found in 40 percent of the tips of Jeffrey pine surveyed in one location on the Tahoe National Forest near Truckee. The shoot moth was suspected of being an important cause of reduced growth of pines in eastern California and Oregon.

The importation into California of the Nantucket pine tip moth, *Rhyacionia frustrana* (Comstock), was discovered in 1971 with the detection of the pest in parts of San Diego, San Bernardino, and Kern Counties.

The boundaries of these infestations are not known to have expanded since 1974, but new spots within the boundaries were found. Information on the tip moth incidence is maintained by the San Diego County Pest Detection Grid Survey and Statewide nursery inspections. In California, the principal host was Monterey pine, and serious damage occurred to ornamental pines and to Christmas tree farms and nurseries.

The pine resin midge, *Cecidomyia piniiopis* O.S., was reported damaging young pines, and Douglas-fir gall midges, *Contarinia* spp., remained active in small Douglas-fir in a few locations.

Status of Insects—Hawaii

Two-lined ohia borer, *Plagithmysus bilineatus* Sharp. The Forest Service, Institute of Pacific Islands Forestry (IPIF), found that *P. bilineatus* may play a major role in the decline of the ohia forests on the island of Hawaii. IPIF researchers were attempting to determine if the borer is a primary or a secondary attacker of ohia and its role in the ohia decline. Generally, however, this cerambycid is considered to be a secondary pest attacking weakened ohia trees.

Black twig borer, *Xylosandrus compactus* Eichhoff. Large black twig borers were discovered attacking a forest pest weed, *Clidemia hirta,* in the Koolau Range on the Island of Oahu. It was thought that the borer population would build up on *C. hirta* and spread to the existing native and exotic forest trees, so specimens of a parasite of the black twig borer were obtained from Indonesia. The parasites closely fit the description of *Tetratichus xylebororum* Domenichini. The specimens were sent to Dr. Domenichini in Italy and were positively identified as *T. xylebororum.* Efforts were underway to obtain live specimens of the parasite for possible biological control of the black twig borer.

Eurasian pine aphid, *Pineus pini* Koch. During the past year, the Eurasian pine aphid spread further into the Kula Forest Reserve. Last year only a single tree in the Kula Forest Reserve was detected with the pine aphid. The combined effects of the increased pine aphid infestation and drought resulted in the death of many pine trees.

Acacia psyllid, *Psylla uncatoides* (Ferris & Klyver). The annual buildup of the acacia psyllid occurred again March through June on the island of Hawaii on *Acacia koa* and *A. koaia,* corresponding with the terminal flushing of the trees. The introduced ladybird beetle, *Harmonia conformis,* continued to suppress the psyllid populations on koaia, but failed to control the psyllid on koa, which resulted in considerable shoot dieback.

The cyclamen mite, *Stenotarsonemus pallidus* (Banks). During the early part of the year many native Hawaiian mountain naupaka, *Scaevola gaudichaudiana,* were heavily infested with the cyclamen mite. The mites generally feed on the new terminal buds, and the damaged is expressed as curled leaves. This infestation is more or less cyclic, and the plants generally recover so that control measures are not required.

Formosan subterranean termite, *Coptotermes formosanus Shiraki.* Scattered individual living trees were found infested with the Formosan subterranean termite. The following tree species were attacked: Brush box, *Tristonia conferta;* Java plum, *Eugenia cumini;* swamp mahogany, *Eucalyptus robusta;* and blackbutt eucalyptus, *E. pilularis.* Continued surveillance will be maintained in areas of the attack to determine if other live trees are attacked by *C. formosans.*

Eucalyptus longhorn beetle, *Phorocantha semipunctata* Fabr. This cerambycid beetle was detected attacking several weakened 5-year-old blackbutt eucalyptus, *Eucalyptus pilularis,* on

the island of Kauai. The beetle appeared to be a secondary invader of *Eucalyptus* species.

Pinhole borer, *Platypus externedentatus* Sairm. This ambrosia beetle was detected attacking pole-size, drought-weakened *Eucalyptus robusta* on the island of Oahu. Other trees attacked by this beetle include lemon-gum (*Eucalyptus citriodora*) and monkeypod (*Samanea saman*).

Status of Diseases—California

Air pollution. Air pollution continued to affect the forests adjacent to the San Joaquin, South Coast, San Diego, and Sacramento Air Basins.

Data from smog evaluation plots on the Los Padres and Sequoia National Forests indicated that the percent of smog-affected trees in those plots remained high and that the relative severity of the disease was increasing.

Dutch elm disease. Dutch elm disease, caused by *Ceratocytis ulmi* (Buism.) C. Moreau, was first confirmed in California in August 1975 in Sonoma County and was later found in Napa and Santa Clara Counties. The California Department of Food and Agriculture began a cooperative effort to combat the spread of this disease in Napa and Sonoma Counties.

F–523678

Figure 5.—Mortality of Douglas-fir. An unknown canker disease, perhaps *Dermea pseudotsugae* or a *Phomopsis* species, contributed to the deaths of many Douglas-firs in Del Norte, Siskiyou, Humboldt, and Trinity Counties, Calif. Flatheaded fir borers were involved in the mortality also.

F–523679

Figure 6.—Mortality of Douglas-fir. Dead and dying Douglas-fir were found over 200–300 square miles of forest in Humboldt and Siskiyou Counties, Calif. Although flatheaded fir borers killed most of these trees, poor growing conditions and an unknown canker disease contributed to the widespread and increasing mortality.

Stem and branch cankers. Above-normal spring rainfall in 1974 and 1975 resulted in an increased incidence of branch and stem cankers, especially in the northern part of the State. *Dermea pseudotsugae* Funk was widespread in Douglas-fir plantations. This organism was tentatively attributed with causing top-kill in Douglas-fir in natural stands in Del Norte, Siskiyou, Humboldt, and Trinity Counties, and contributing to the deaths of saplings, poles, and sawtimber (fig. 5). Although the canker, poor site, and possibly weather were predisposing factors, the fir flatheaded borer ap-

peared to be the immediate cause of widespread tree mortality (fig. 6.).

A branch canker of white fir, caused by *Cytospora abietis* Sacc., continued to cause extensive branch dieback and some tree mortality in Plumas and Lassen Counties. The infection was particularly heavy in one stand in Plumas County, where almost every fir was infected and many trees had died.

Needle diseases. Above-normal spring rainfall in 1974 and 1975 contributed to a high incidence of needle rusts in true firs in the northern counties, and to a needle cast of sugar pine, caused by *Lophodermella arcuata* (Darker) Darker, in the central Sierra Nevada.

White pine blister rust. *Cronartium ribicola.* Two new rust infection centers were reported in Tulare County: at Surprise Grove in Sequoia National Park, and in Case Mountain Grove on Salt Creek Ridge.

Root rots. Three major root-rotting organisms–*Fomes annosus* (Fr.) Cke., *Armillaria mellea* Vahl. ex Frt., and *Verticicladiella wageneriі* Kendrick–continued to cause mortality and windthrow in various parts of the State. *Fomes annosus* killed about 100 madrone trees (*Arbutus menziesii* Pursh.) in three centers in Placer County; this was believed to be the first report of *F. annosus* in madrone (fig. 7).

Field work was completed on the *Fomes annosus* survey conducted in the eastside pine type on the Modoc National Forest, Modoc County. These data, combined with 1973 and 1974 data, will be used to develop recommendations for managing timber in stands infected with the disease.

Nursery diseases. Douglas-fir sown in 1974 suffered severe losses in the Humboldt Nursery, Humboldt County. Approximately 4 million seedlings were killed by *Phoma* sp., a fungus that completely defoliates seedlings. Some of the trees that survived the *Phoma* attack were then infected by *Phomopsis lokoyae* Hahn, which caused additional losses. *Sirococcus strobilinus* (Desm.) Petr. caused losses in 1–0 and 2–0 Jeffrey pine, and in 1–0 ponderosa pine.

In a fumigation plot at the Placerville Nursery, Eldorado County, *Fusarium oxysporum* Schlect. amend. Snyd. & Hans caused major losses in sugar pine, and minor losses in Douglas-fir, red fir, and white fir. Elsewhere in the nursery, *Phytophthora* sp. caused losses in sugar pine.

Dwarf mistletoe. In 1973 and 1974, the Forest Service surveyed campgrounds throughout California to determine the mortality rate of pines infected by dwarf mistletoe. Field crews set up plots at Laguna Campground in the Cleveland National Forest, at Nevada Beach in the Lake Tahoe Basin Management Unit, and at Merrill Cave and at Bridge Campgrounds in the Lassen National Forest. Each year, as trees died and were removed from the campgrounds, local foresters reported to FI&DM the cause of death and age of each dead tree.

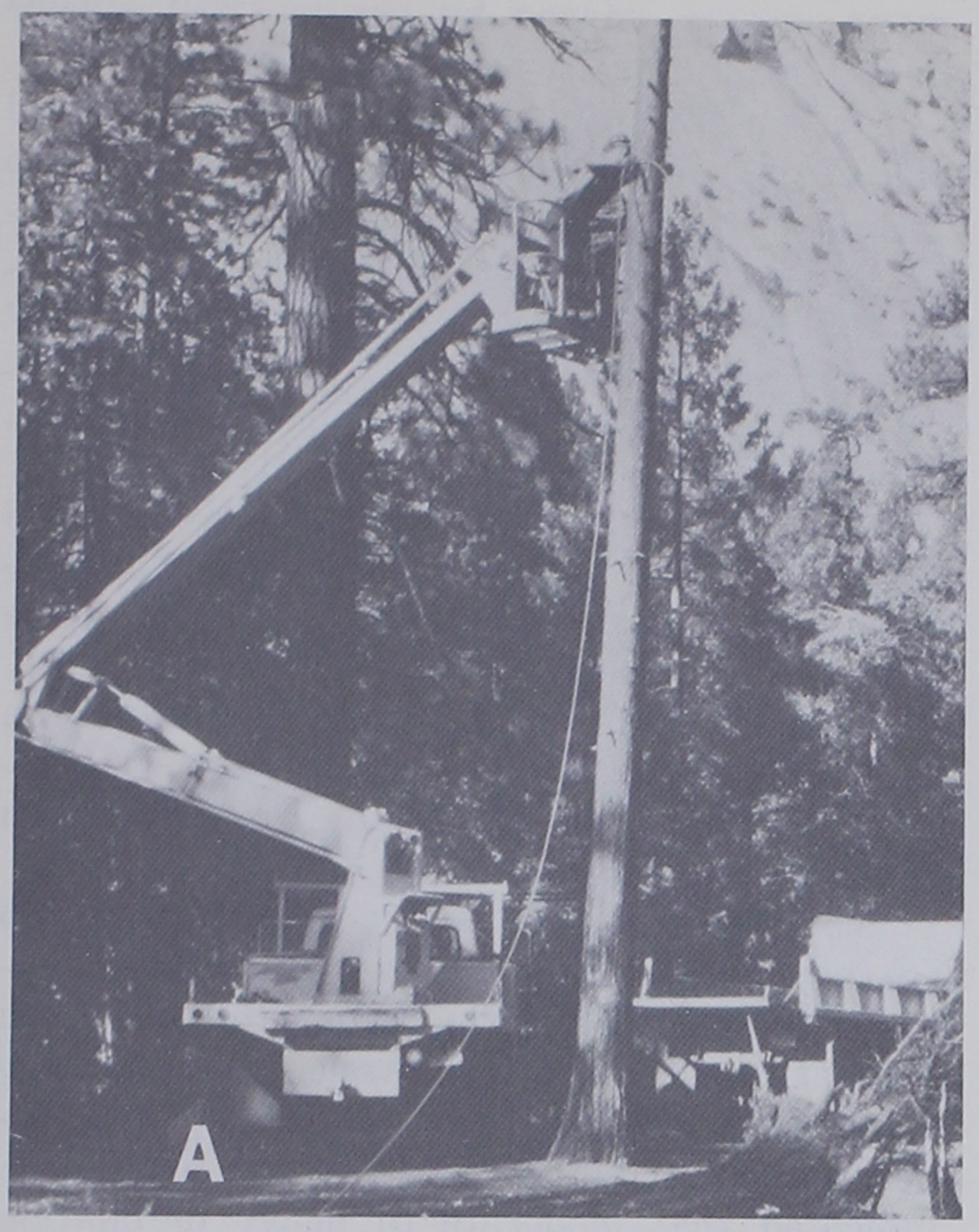
Tree mortality was most notable at Laguna Campground. Within the original 973-tree plot, 277 trees (29 percent) were uninfected. Since 1973, 21 pines have died; of these, only one was uninfected and 17 were infected throughout one-half or more of the crown.

Road deicing salt. A biological evaluation of roadside conifer damage in San Bernardino County determined that most of the damage was caused by highway deicing salt. Damage was concentrated along Highway 38 from Camp Angeles to Onyx Summit, with scattered damage throughout the San Bernardino National Forest where highway deicing salt was used.

Status of Diseases—Hawaii

Ohia forest decline. Ohia forest decline remained as the State's most destructive forest disease problem (fig. 8.). Over 250,000 acres of ohia forests on the island of Hawaii were affected, and the native cerambycid beetle was believed to be one of the factors involved. The trees may have been predisposed to beetle attack by the root rot fungus, *Phytophthora cinnamomi* Rands. Physical factors such as weather were also suspected in the decline of the ohia forest. It appeared that the decline was due to a complex of factors.

Needle cast, *Lophodermium pinastri* (Schrad. ex Hook.) Chevallier. Needle cast disease continued to be a problem on Monterey and pinaster pine stands on the islands of Molokai and Maui. *L. pinastri* was also detected on a small pinaster stand on Kauai during the past year. The needle cast fungus took its greatest toll in Molokai, where 300 acres were infested.



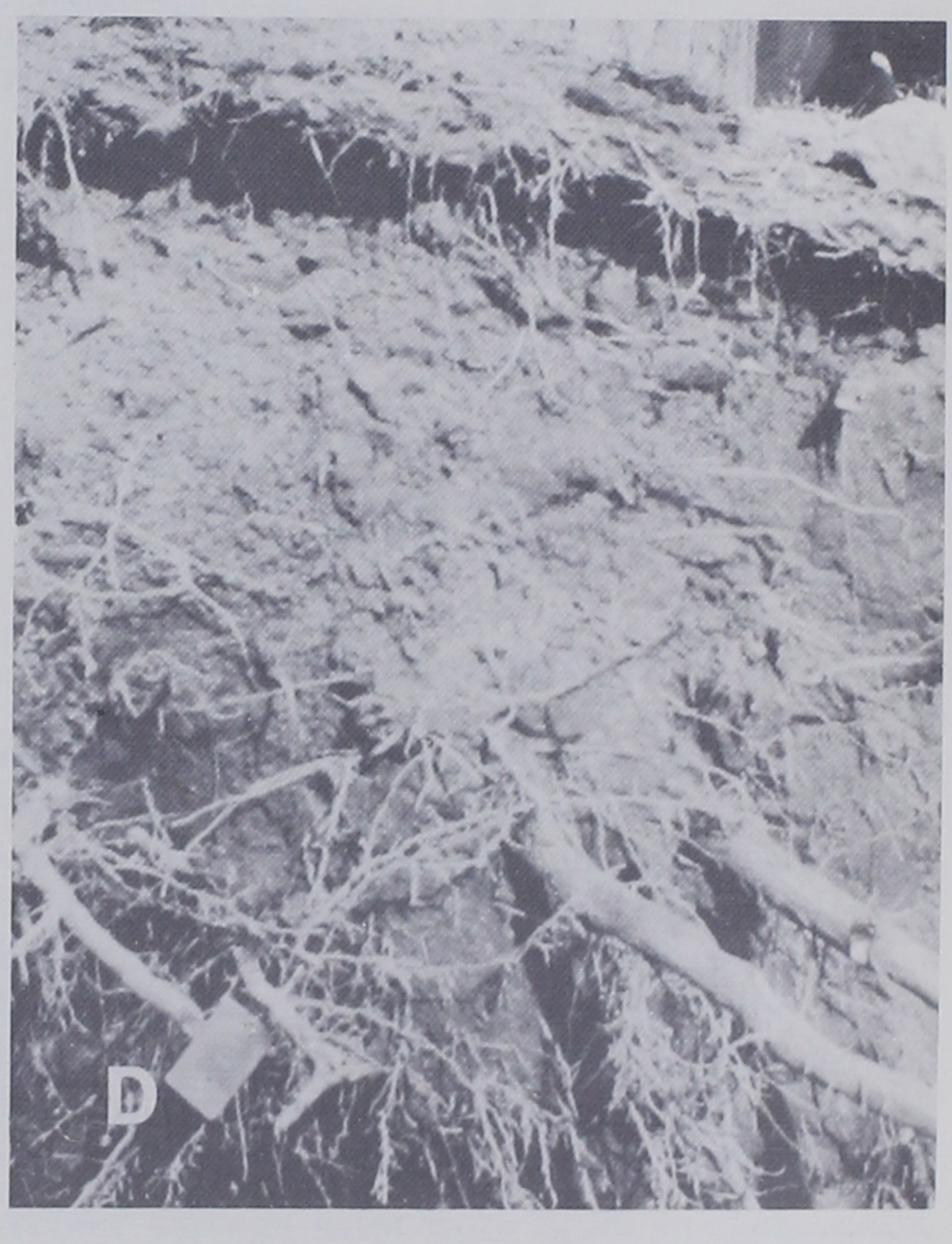


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Figure 7.—Risk rating incense-cedars infected by *Fomes annosus*. University of California and Forest Service plant pathologists and National Park Service personnel examine the roots of declining incense-cedars in Yosemite Valley. *A*, Rigging a fading cedar preparatory to pulling it over; *B*, a topped tree being uprooted; *C*, an uprooted cedar with much of its supporting root system rotted; *D*, symptoms and implications of annosus root rot.

F–523684

Figure 8.—Dead and dying ohia trees stand bare, without leaves to shade thousands of acres of native forest land on Hawaii.

INTERMOUNTAIN STATES (R–4)[8]

by

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Conditions in Brief

The mountain pine beetle and the western spruce budworm remained the two most damaging insects in the Intermountain Region during 1975. Mortality caused by mountain pine beetle decreased Regionwide, but increased locally in some areas of the Targhee National Forest, Idaho, and in the Ashley National Forest, Utah. Regionwide defoliation of Douglas-fir subalpine fir, grand fir, and Engelmann spruce, caused by the western spruce budworm, increased significantly in 1975.

The mountain pine beetle attacked and killed practically all species of pine found in the Intermountain Region. Lodgepole pine sustained the heaviest losses in parts of Idaho, Wyoming, and Utah. Scattered ponderosa pine mortality occurred in small areas of Idaho, Utah, and California. Jeffrey pine, whitebark, and limber pine losses were widely scattered.

The Engelmann spruce beetle infestation in central Utah continued its rapid decline, following its peak in 1973. Efforts to salvage the dead material continued.

The Douglas-fir beetle outbreak declined on the Targhee National Forest, Idaho, but increased on the Boise, Salmon, and Sawtooth National Forests, Idaho.

The western spruce budworm continued to be the most damaging and widespread defoliator during 1975. The extent of budworm defoliation increased in all areas where damage occurred in 1974, and one new area of infestation was reported. Anaylsis of egg mass data indicated that moderate to heavy defoliation will continue in most areas in 1976. Other defoliators were observed but were only of local importance.

Dwarf mistletoe continued to be the most serious forest disease of the Intermountain Region, and much emphasis and effort were exerted to reduce losses to this pathogen. Vegetation plots established around two coal-fired generating stations to assess effects of unrestricted release of sulfur dioxide were visited and photographed. A number of *Fomes annosus* infection centers were located on old timber sales. An infestation of *Cytospora* canker in white fir was also examined.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. The most damaging infestation of the mountain pine beetle continued on the northern portion of the Targhee National Forest, Idaho. Heaviest tree killing occurred in the Island Park area, with the largest increase in new attacks around the base of Sawtell Peak. To the east, in the high-elevation stands in Yellowstone National Park, tree killing decreased as expected.

[1] Includes forested lands in Utah, Nevada, southern Idaho, western Wyoming, and eastern California.

F–523685

Figure 9.—Bark beetle traps used on lodgepole pine trees treated with a protective chemical in Buffalo Campground, Targhee National Forest, Idaho.

Over the course of this outbreak on the Targhee Forest, more than 45 percent of the stand and 60 percent of the merchantable volume were killed. Efforts were made to salvage dead and threatened timber. Salvage sales under contract totaled 52 MMBF.

Killing of Jeffrey pine, ponderosa pine, lodgepole pine, and limber pine continued in widely scattered areas on the Toiyabe National Forest, Calif. Heaviest damage occurred south of Lake Tahoe, west of Markleeville, and in the East Fork of the Carson River.

Except for areas along the Snake River just south of the Yellowstone boundary and the lower Gros Ventre River, mountain pine beetle activity was at a very low level in Grand Teton National Park and on the Bridger-Teton National Forest, Wyo.

Renewed bark beetle activity continued to increase on the Wasatch and Ashley National Forests, Utah. Heaviest mortality on the Wasatch occurred in the Bear River drainage on National Forest, Bureau of Land Management (BLM), and private lands. The infestation on the Ashley stimulated an aggressive timber sale program to utilize threatened timber and to retard the progress of this infestation.

Many active mountain pine beetle infestations occurred on the Cassia Division, Sawtooth National Forest, Idaho. Annual losses appeared to occur at a constant rather than at an accelerated annual rate. Industry planned to increase mill capacity in the area, and a proposed sale would remove at least half of the more susceptible old growth and allow natural regeneration.

Elsewhere, mountain pine beetle continued to cause heavy tree mortality in both lodgepole and ponderosa pine stands from McCall to Round Valley on the Payette and Boise National Forests, Idaho. The majority of these infested stands were on private lands adjacent to the Forest.

Engelmann spruce beetle, *Dendroctonus rufipennis* (Kirby). The once-serious Engelmann spruce beetle outbreak in upper Huntington Canyon, Manti-LaSal National Forest, Utah (fig. 10), declined to widely scattered tree killing. Heaviest mortality occurred in Lake Canyon, Boulger Canyon, and Swens Canyon. Prior to 1974, between 26 and 82 percent of the merchantable volume had been killed, most of which is still sound. Efforts to salvage this timber continue, but limited mill capacity has seriously delayed progress.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. The damaging outbreak of the Douglas-fir beetle continued to cause heavy loses throughout much of the northern portion of the Targhee National Forest, Idaho. As predicted in 1974, Douglas-fir mortality decreased slightly in 1975. This represented the first decrease in tree killing since the initial buildup in 1969. Although the infestation has reached its peak and has now started to decline, many stands remain that are highly susceptible to bark beetle attack. Heavy tree killing will continue for several years in some areas until the infestation subsides.

Scattered but increasing infestations of the Douglas-fir beetle occurred on the Boise, Salmon, and Sawtooth National Forests, Idaho, and in the Idaho Primitive Area. On the Boise National Forest, heaviest mortality occurred in the Boise River drainage between Cottonwood Creek and Queens River. Several helicopter salvage sales were made in these areas. Douglas-fir beetle activity on the Salmon National Forest, Idaho, was concentrated on the

F–523686

Figure 10.—Engelmann spruce mortality caused by the Engelmann spruce beetle near Huntington Reservoir on the Manti-La Sal National Forest, Utah.

west division of the Forest, mainly in the Panther Creek drainage, including much of Little and Big Deer Creeks and the Beaver and Clear Creek drainages. Many of these infestations were located in inaccessible areas. The largest increase in beetle-caused mortality of Douglas-fir occurred on the northern division of the Sawtooth National Forest. Highest losses of prime timber occurred within the South Fork of the Boise River drainage between Featherville and Carrietown.

Western pine beetle, *Dendroctonus brevicomis* LeC. On the Boise National Forest, Idaho, a western pine beetle outbreak in heavily overstocked ponderosa pine took a dramatic upturn in 1975. A large commercial thinning sale was made of infested trees before beetle flight.

Western spruce budworm, *Choristoneura occidentalis* Free. Regionwide, western spruce budworm populations vacillated over a wide range for the past two decades, with a high of over 2 million acres infested in 1964. In recent years, defoliation averaged approximately 350,000 acres. The 733,000 acres defoliated during 1975 represented a marked increase over 1974 and the largest infested area since 1966.

The Targhee and Bridger-Teton National Forests showed the largest increase, with 1,500 acres and 18,900 acres, respectively, in 1974; and 36,900 acres and 119,200 acres, respectively, in 1975. Areas of heaviest defoliation were in Pleasant Valley and north of Henry's Lake on the Targhee, and Willow Creek, Horse Creek, Snow King Mountain, and tributaries of the Greys River on the Bridger-Teton. Egg mass data indicated moderate to heavy defoliation will continue on both Forests in 1976.

The Payette National Forest, Idaho, exhibited the largest infestation, with over 400,000 acres of visible defoliation. Areas of heaviest

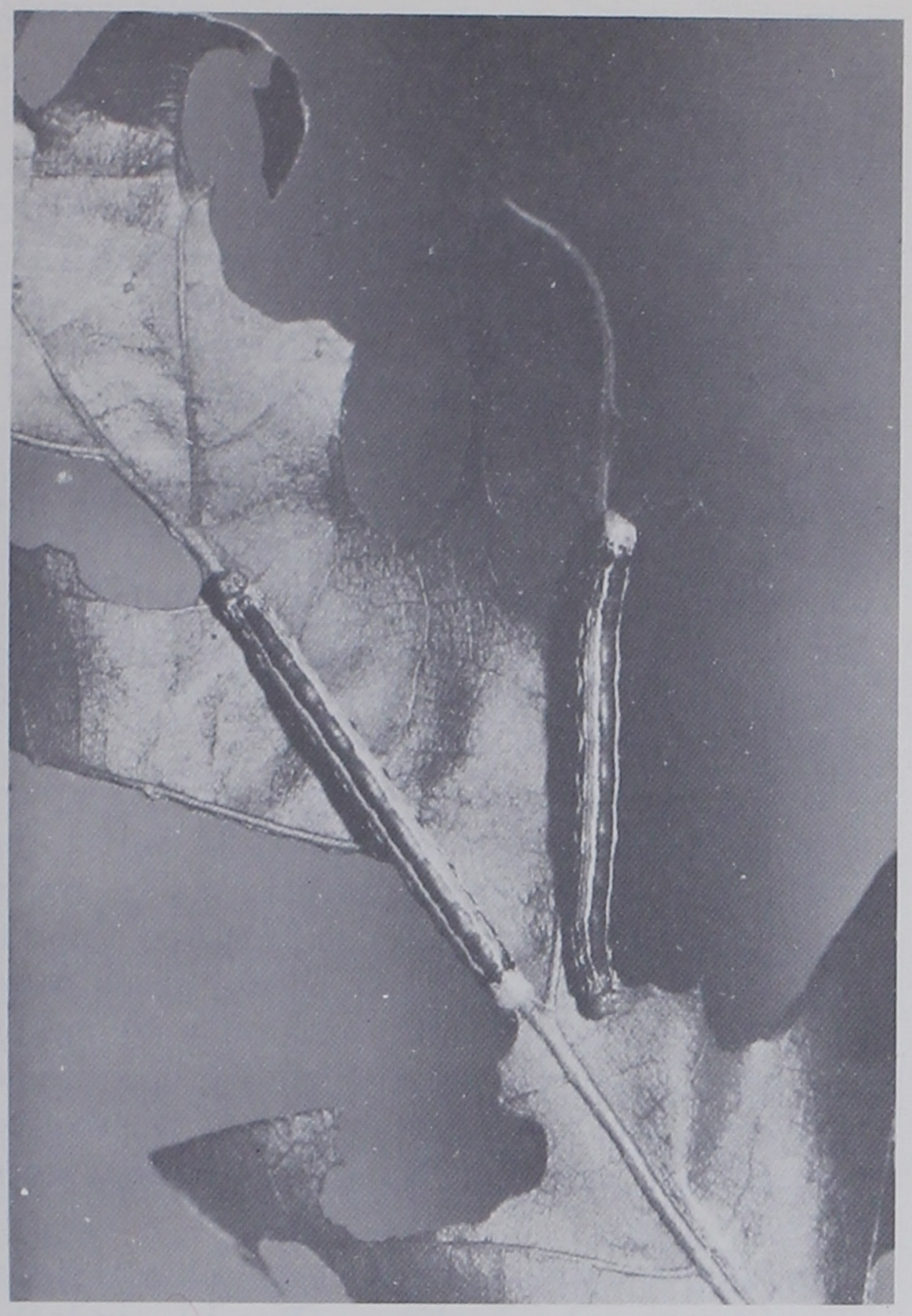

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Figure 11.—Fall cankerworm larvae feeding on gambel oak in Utah.

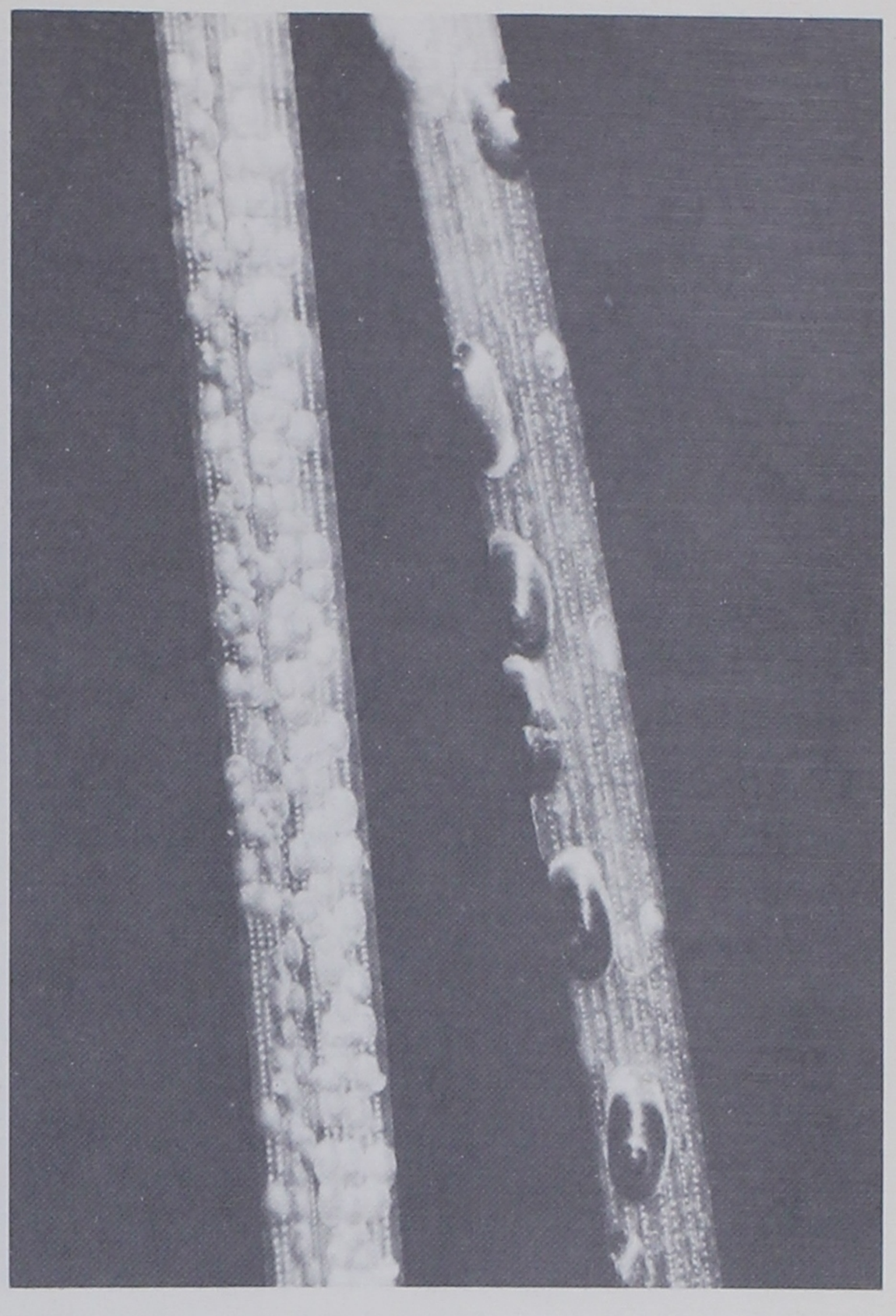

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Figure 12.—Black pine leaf scale on Jeffrey pine in Genoa, Nev.

defoliation on the Payette were No Business Mountain, Fawn Creek, Willow Creek, Rapid Creek, Paddy Creek, and Brundage Mountain.

Increased areas of defoliation were also recorded on the Boise, Challis, and Salmon National Forests, Idaho. A new 300-acre area of defoliation was reported on the Caribou National Forest, Idaho.

Fall cankerworm, *Alsophila pometaria* (Harris). For the second consecutive year, moderate to heavy defoliation caused by the fall cankerworm was reported in lower Corn Creek, Fishlake National Forest, Utah. Heaviest defoliation occurred on boxelder and gambel oak (fig. 11), with only light to moderate defoliation on bigtooth maple and chokecherry. All trees refoliated following larval feeding, and no permanent damage was expected.

This insect also caused light to moderate defoliation of boxelder, bigtooth maple, gambel oak, chokecherry, and domestic apple along the Wasatch Front between Ogden and Salt Lake City, Utah.

A tent caterpillar, *Malacosoma incurvum discoloratum* (Neumoegen). As predicted from egg mass data collected in 1974, defoliation of Fremont cottonwood by this tent caterpillar decreased to a level of little consequence during 1975 along the Fremont River in Capital Reef National Park, Utah. Only scattered tents were found on Fremont cottonwood near the visitor Center. Elsewhere, defoliation was not evident. Negligible tent caterpillar activity in the Park is expected in 1976.

Black pine leaf scale, *Nuculapsis californica* Coleman. Heavy defoliation of Jeffrey pine caused by this scale occurred on private lands near Genoa, Nev. (fig. 12). Initially detected in 1974, defoliation and other tree damage increased in 1975. Counts of overwinter scales indicated that defoliation will be heavy to severe in 1976. Some tree mortality occurred

F–523689

Figure 13.—Parasitized larva of the brown day moth.

in the small trees, and many branches and terminals appeared to be dead.

Brown day moth, *Pseudohazis eglanterina* (Bdv.). A previously undetected outbreak of the brown day moth (fig. 13) was reported in several locations in eastern Nevada and southern Utah. Scattered areas of snowberry and serviceberry showed heavy to extreme defoliation in the Ward and Nokomoke Mountains, Humboldt National Forest, Nev. Light defoliation was found in several areas on the Dixie National Forest and in Bryce Canyon National Park, Utah.

A sawfly, *Neodiprion fulviceps* (Cresson). No tree mortality has occurred after 6 years of heavy defoliation caused by this sawfly in a small stand of ponderosa pine in Clear Creek, Fishlake National Forest, Utah. The progress of the infestation will be closely followed to record the long-term impact on host trees. As of 1974, no apparent decrease in radial growth was observed.

White fir needle miner, *Epinotia meritana* Heinrich. After several years of moderate to heavy defoliation, white fir in portions of the Dixie National Forest and in Bryce Canyon National Park showed signs of recuperation during 1974. This respite was followed in 1975 by a dramtic increase in the needle miner population, which resulted in heavy defoliation in many of the already devitalized trees.

A leafroller, *Archips negundanus* (Dyar). A persistent infestation of this leafroller has caused heavy defoliation of boxelder throughout most of the rural areas of northern Utah for 8 years. Despite this unusually long outbreak, trees refoliated each midsummer and apparently suffered no damage.

Gypsy moth, *Lymantria dispar* (L.). As part of a westwide cooperative effort to detect the gypsy moth, pheromone-baited traps were placed in several locations at Zion and Capital Reef National Parks, Utah. These areas were selected because of their proximity to major east-west travel routes, availability of suitable host trees, and the large number of westbound recreational vehicles. No gypsy moths were found in 1975.

Defoliator complex. The sugar pine tortrix, *Choristoneura lambertiana* (Busck), and the pine needle sheath miner, *Zelleria haimbachi* Busck, caused light to moderate defoliation of lodgepole pine on 15,000 acres on the Targhee National Forest, Idaho, and on 5,000 acres on the Bridger-Teton National Forest, Wyo. The trend of this infestation is unknown. The sugar pine tortrix also damaged a thinned stand of lodgepole pine on private land near Donnelly, Idaho.

Status of Diseases

Dwarf mistletoe, *Arceuthobium* spp. Dwarf mistletoe was controlled on approximately 930 acres of National Forest lands in Idaho and Utah. In Idaho, ponderosa pine infested with *A. cryptopodum* Engelm. and Douglas-fir infested with *A. douglasii* Engelm. were treated. In Utah, ponderosa pine infested with *A. vaginatum* subsp. *cryptopodum* Engelm. (Hawks. and Wiens) was treated.

Air pollution. Broad-leafed and conifer vegetation around the Navajo Generating Station at Page, Ariz., and at the Huntington Canyon

Generating Station south of Price, Utah, was examined for damage caused by unrestricted release of sulfur dioxide. No damage attributable to the effects of sulfur dioxide upon succulent foliage was found.

Root diseases. Three areas of *Fomes annosus* (Fr.) Cke. infection were found in central Idaho. On the Council Ranger District of the Payette National Forest, Idaho, the approximately 15 *F. annosus* centers found in one area had killed natural and planted ponderosa pine regeneration. Two additional centers found on the New Meadows Ranger District of the Payette National Forest were killing planted ponderosa pines. The one center found on the Ola Slope Area of the Emmett Ranger District, Boise National Forest, had caused mortality of sawlog and pole-size ponderosa pine. One infection center was found on Nevada State land on the east side of Lake Tahoe, where true fir seedlings and saplings were being killed. All infection centers found were in old timber sale areas.

Cytospora canker. White fir, *Abies concolor* (Gord. and Glend.) Lindl., on Canaan Mountain and in the Cabbage Flat area of the Escalante Ranger District, Dixie National Forest, Utah, were found to be severely infested with cankers caused by a fungus of the genus *Cytospora*. Branch and top-kill were occurring. Mortality of some smaller trees occurred, and trees on approximately 2,900 acres were affected.

NORTHERN ROCKY MOUNTAINS [2] (R–1)

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Conditions in Brief

Several major forest insect pests continued to deplete forest resources in the Northern Region in 1975. Western spruce budworm defoliated firs and spruce on almost 5 million acres in Montana, Idaho, and Wyoming. Douglas-fir tussock moth damage was reported in Coeur d'Alene, Idaho, and in two small spots totaling 26 acres in western Montana. Larch casebearer defoliation was heavy on 23,734 acres on the Idaho Panhandle and Clearwater National Forests, Idaho, and on the Kootenai National Forest, Mont. The pine needle sheath miner defoliated lodgepole pine on 21,627 acres in Montana and Idaho.

Mountain pine beetle infested lodgepole pine stands on the Lolo, Kootenai, Beaverhead, and Gallatin National Forests in Glacier National Park, Mont., and in Yellowstone National Park, Wyo. Second-growth ponderosa pine stands were heavily infested on the Lolo, Bitterroot, Helena, and Lewis and Clark National Forests, and on the Crow Indian Reservation, Mont. Chronic infestations also persisted in old-growth white pine stands in Idaho and Montana.

Several groups of trees killed by the Douglas-fir beetle were detected in 1975. Pine engraver beetles were active on the Lolo National Forest and the Flathead Indian Reservation, Mont. Fir engraver beetle damage was widespread and heavy in grand fir stands over most of northern Idaho and western Montana. The western balsam bark beetle remained a chronic killer of subalpine fir in the Region. Western pine beetle damage to mature ponderosa pine increased on the Nezperce National Forest, Idaho.

The forest tent caterpillar defoliated hardwoods near Evaro and Libby, Mont.; western false hemlock looper infestations collapsed.

Although airborne spores of *Fomes annosus* were abundant in one area in western Montana, mortality caused by this fungus was minimal. On the basis of expanded survey information, an estimated 5.1 percent of the Coeur d'Alene National Forest was included in root-disease centers. No important decay fungi were found in tree top-kill by insect defoliation 10 and 25 years ago, and mortality in 2–0 seedlings at the Coeur d' Alene Nursery was only 3 to 4 percent. Estimates of *Fusarium* populations in soil indicated that soil fumigation at the nursery varied from effective in some beds to unnecessary and possibly detrimental in others. One additional case of Dutch elm disease was confirmed in Missoula, Mont.

[2] Includes forested lands in Montana, northern Idaho, North Dakota, northwestern South Dakota, and National Park Service land in northwestern Wyoming.

Status of Insects

Western spruce budworm, *Choristoneura occidentalis* Freeman. Visible defoliation extended over 3,898,981 acres of the Northern Region during 1975, exclusive of the Nezperce National Forest, Idaho. Although the data were incomplete, the budworm population in the Nezperce National Forest appeared to have collapsed dramatically. Table 1 (Appendix) shows acres defoliated by the western spruce budworm during 1973, 1974, and 1975.

Fall egg mass surveys made on the Beaverhead, Deerlodge, Flathead, Gallatin, Helena, and Lolo National Forests, Mont., indicated that defoliation will occur at about the same intensity in 1976 as in 1975, but the number of acres infested is expected to increase. In western Montana and northern Idaho, infestations should remain static or decrease in 1976.

Douglas-fir tussock moth, *Orgyia pseudotsugata* McDonald. The 1974 outbreak in northern Idaho collapsed at the end of the season because of spraying with DDT, parasitism, predation, and disease. No defoliation was visible from the air in 1975. In the city of Coeur d' Alene, however, several ornamental trees were infested with tussock moth larvae. Traps baited with female Douglas-fir tussock moth sex pheromone were placed on 323 plots throughout northern Idaho from the Canadian border to Riggins. Tussock moths were caught in all areas baited, but not on every plot. Pheromone traps showed promise as a survey tool for detecting future population buildups.

In Montana, defoliation was detected on 10 acres of Douglas-fir near Missoula and on 16 acres of the Flathead Indian Reservation, where populations were previously reported in 1974. Parasites killed 7.7 percent of the pest population; nucleopholyhedral virus killed 48.6 percent; and unknown factors killed 43.4 percent. Fall egg mass surveys indicated that negligible defoliation will occur in this area in 1976.

Male tussock moths were attracted to 69 out of 125 pheromone-baited traps in Montana. Moths were trapped in west-central Montana, from Whitefish south to Darby, but were not collected east of the Continental Divide.

The impact of 1 year of severe defoliation was determined from Douglas-fir stands on the Nezperce National Forest, Idaho; results showed that most defoliated trees suffered a 30-percent reduction in radial growth for 2 years following defoliation.

Larch casebearer, *Coleophora laricella* (Hbn.). In 1975, heavy defoliation by this insect occurred on 20,000 acres on the Panhandle National Forest, Idaho; on 3,000 acres on the Clearwater National Forest, Idaho; and on 1000 acres, on the Kootenai National Forest, Mont. Light infestations also occurred throughout the larch type of the Northern Region.

Efforts to control the larch casebearer have centered around the introduction of parasitic wasps. For several years, new species of these parasites have been released within larch stands near Evaro, Mont. (fig. 14). In 1975, 401 *Elachertus argissa* (Walker) and 365 *Necremnus metalarus* (Walker) were liberated in this area. Success of establishment of these releases will be determined in 1976.

Pine needle sheath miner, *Zelleria haimbachi* (Busck). Infestation and noticeable defoliation by this insect increased during 1975 in the Northern Region. Approximately 2,956 acres of lodgepole pine were lightly defoliated on the Flathead National Forest and near Lake McDonald inside Glacier Park, Mont. Visible defoliation was also detected on the eastern half of the Lolo National Forest, Mont., and on 300

F–523690

Figure 14.—Releasing wasp parasites of the larch case bearer near Evaro, Mont.

acres on the Powell District of the Clearwater National Forest, Idaho.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. Mountain pine beetle continued to decimate lodgepole, ponderosa, and western white pine stands in the Northern Region in 1975.

Infestations in lodgepole pine. From 1972–74, approximately 118,486 lodgepole pine were killed, including 5.7 MMBF on Forest Service, Burlington Northern, and U.S. Plywood lands in the Lazier and Meadow Creek drainages of the Lolo National Forest, Mont. New epicenters, ranging from 3 to 100 trees per group, were detected throughout the Thompson River drainage on Federal, State, and private lands. New infestations developed near old epicenters on Federal, State, and private lands near St. Regis and Superior, Mont., and are expected to intensify in 1976.

The infestation increased in the Upper Yaak River drainage of the Kootenai National Forest, Mont. In excess of 75,000 trees were infested in 1975, with hot spots in Solo Joe, Caribou, Basin, and Vinal Creeks, and the West Fork of the Yaak River drainages. Heavy losses are expected to continue in 1976. Accelerated salvage logging was planned to remove susceptible trees and to convert susceptible stands to younger age classes to alleviate losses.

An outbreak started in 1974 in Jack Creek east of Ennis, on the Beaverhead National Forest, Mont., spread considerably in 1975, and killed about 10,000 trees on 2,750 acres of Burlington Northern and 2,800 acres of Forest Service lands. Approximately 400 trees were killed along Cliff Lake and Hidden Lake benches.

Infestations occurred on approximately 113,704 acres of the Gallatin and Hebgen Lake Ranger Districts, Gallatin National Forest, Mont. Surveys indicated an average of 56 infested trees per acre and a volume loss of 23.555,860 board feet in the past 3 years. Tree mortality is expected to continue at a high level, with several new outbreak centers developing in 1976.

The Yellowstone National Park infestation increased from 275,200 acres in 1974 to 692,228 acres in 1975. Infested trees occurred from Teton National Park to the Gallatin National Forest boundary.

Groups of dying trees were scattered along the west side of Glacier National Park, Mont., from Dutch Creek northwest to Kintla Lake, and epicenters occurred in Logging, Quartz, and Bowman Creek drainages and on the southeast slopes of Kintla Lake–a total of more than 8,500 infested acres. Infestations are expected to enlarge with increased tree mortality in 1976.

Infested groups of from 5 to 200 trees were scattered throughout the Pleasant Valley complex on State and private lands within the boundaries of the Fisher River Ranger District, Kootenai National Forest, Mont.

Infestations in ponderosa pine. More than 5,000 dead trees were detected west from Evaro, Mont., and up Ninemile Creek drainage in second-growth ponderosa pine on the Ninemile Ranger District, Lolo National Forest, Mont. Thinning operations were extended on the Ninemile Ranger District to reduce the infestation.

The Bitterroot Valley in Montana contained widely scattered infestations on private lands. Greatest tree mortality occurred on the south facing slopes of Eightmile Creek, where about 500 trees were killed. Infested trees were also detected in Larry, Brooks, Threemile, Silverhorn, Spoon, and Spade Creek drainages. The Bitterroot National Forest, Mont., reported 150 dead trees on the West Fork Ranger District and 350 dead trees on the Magruder District. More than 400 trees were killed southwest of Helena, Mont., in Grizzly, Squaw, and Orofino Gulches. Four groups, totalling about 70 trees, were attacked east of Marysville on private land, and over 600 second-growth ponderosa pine were killed from Lincoln Gulch east to Keep Cool Creek, Lincoln Ranger District, Helena National Forest, Mont.

Approximately 1,200 trees were killed on the lower half of Tenderfoot Creek drainage, White Sulphur Springs District, Lewis and Clark National Forest, Mont., and on private lands in Blacktail and Spring Creek drainages. Heavy tree kill was mainly on private lands south and east of the Big Snowy Mountains and within and northwest of the Little Snowy Mountains. These infestations have been active since the 1960's and thousands of second-growth trees are killed yearly. Small, scattered

infestations occurred on Monarch Mountain, Belt Creek District, and within Sage and Yogo Creek drainages, Stanford District, Lewis and Clark National Forest.

Infestations have increased for 3 years on Crow Indian Reservation lands and on adjacent private lands south of Lodge Grass, Mont. These infestations are expected to continue in 1976.

Infestations in western white pine. On the Idaho Panhandle National Forest, a few small groups ranging in size from one to five trees of mature pine were killed within the Lightning Creek drainage, which was heavily salvage logged several years ago. Salvage continued in Yellow Dog and Downey Creek drainages on the Wallace District and also in white pine stands on the Fernan District. Salvage logging reduced infestations to innocuous levels in the Red Ives District.

Several small groups of dead trees occurred in Skull and Quartz Creek drainages on the Canyon District, Clearwater National Forest, Idaho.

In Montana, chronic killing continued in pockets of mature white pine around the shores of Hungry Horse Reservoir, Flathead National Forest. On the Kootenai National Forest, Mont., there were 150 beetle-killed trees near the east and north forks of Bull River in the Cabinet District.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Remnants of a previous outbreak that lasted from 1971–73 within the North Fork Clearwater River drainage in Idaho were evident in 1975. Groups of 2 to 20 red-topped trees were scattered from Reeds Creek on the southeast side of the river to Canyon Ranger Station; on the Clearwater National Forest, Idaho, Douglas-fir beetle activity was detected in Skull, Quartz, Rock, Cold Springs, and Sheep Creeks. Douglas-fir beetle kill decreased noticeably over the rest of the northern Region in 1975.

Pine engraver beetle, *Ips* spp. Infestations of these beetles decreased in northern Idaho and Montana since the drought triggered outbreaks of 1973. Small groups of dead ponderosa pine, mainly on State and private lands, occurred along the Clark Fork River, running northwest of Missoula to St. Regis on the Lolo National Forest, Mont. Other groups were concentrated north of Plains in Lunch, Buffalo Bill, and Weeksville Creeks. More than 660 ponderosa pine were killed in all.

Almost all the ponderosa pine stands along the east side of the Flathead Indian Reservation, Mont., from Evaro to north of Polson, contained dead trees. Other hot spots on the Reservation were west of Camas Prairie, northwest of Lonepine, Irving Creek, and northwest of Elmo. Over 1,800 trees were killed.

Fir engraver, *Scolytus ventralis* LeConte. Fir engraver beetle damage was widespread and heavy in grand fir stands over most of northern Idaho and western Montana. More than 1,630 grand fir were killed on the Fernan and Wallace Ranger Districts, Idaho Panhandle National Forest, within the Coeur d'Alene River complex. Only 234 trees were infested from Bonners Ferry south to Athol and north to Priest Lake. Heavy group kills also occurred along the St. Maries and North Fork Clearwater River sand from Troy north to Coeur d'Alene Lake. An estimated 10,000 grand fir were attacked in these areas.

From the North Fork Clearwater River south to the Middle Fork Clearwater River, more than 15,500 trees were killed on State and private lands, and about 280 trees were killed on Forest Service land on the Clearwater National Forest, Idaho. Within the confines of the Nezperce National Forest Idaho, 3,500 trees were attacked. An estimated 800 trees were killed on the Flathead National Forest, and 115 trees were killed on the Flathead Indian Reservation, Mont.

Infested groups of trees were scattered over the entire Kootenai National Forest, Mont. Some of the heaviest damage occurred on the Cabinet Ranger District, where about 400 trees were killed northwest and east of Troy and north and south of Libby, and more than 2,000 trees were killed along the Bull River.

Aerial surveys detected about 2,000 dead trees along the Thompson River, northwest and west of Plains, north of St. Regis, and west of Thompson Falls, Lolo National Forest, Mont.

Western pine beetle, *Dendroctonus brevicomis* LeC. In 1975, aerial surveys of the Nezperce National Forest, Idaho, showed groups of one to five faders widespread over ponderosa pine on the Clearwater, Slate Creek, and Red River Ranger Districts.

F–523691

Figure 15.—Female forest tent caterpillar adult by egg mass on chokecherry branch in Montana.

Other insects. Forest tent caterpillar, *Malacosoma disstria* Hbn. (fig. 15), caused defoliation for the second consecutive year in *Populus* spp. along the Jocko River near Evaro, and along the Fisher River near Libby, Mont.; defoliation will probably continue in 1976. Western false hemlock looper, *Nepytia freemani* Munroe, populations collapsed; there was no visible defoliation detected in 1975. The Ash borer, *Podosesia syringae fraxini* Lugger, remained a serious threat to green ash shelterbelt plantings in North Dakota.

Status of Diseases

Root diseases. Mature sporophores of *Fomes annosus* (Fr.) Cke. were found on the Flathead Indian Reservation in 1974. Spore trapping results of 1975 showed that airborne spores were abundant in the area. Studies were also being planned to determine the potential disease severity of *F. annosus* in the area and, if it were substantial, to evaluate control alternatives.

Analysis of data from a study to evaluate the utility of 35mm photography in determining mortality due to disease agents showed an estimated annual mortality rate of 1.5 trees per acre in an area in northern Idaho. There were 9.8 dead trees (with intact tops) per acre, plus an additional 9.5 green high-risk trees per acre present. The dead and high-risk trees ranged from 5 to 15 inches d.b.h. and included western white pine, lodgepole pine, and Douglas-fir. The majority of the damage was caused by root pathogens, which are expected to accelerate in 1976.

The field portion of a root disease survey of about 2,000 acres on the Pleasant Creek drainage, Idaho Panhandle National Forest, which was completed in 1975, revealed that 8 to 10 percent of the area was infected with root disease centers. The infected areas, however, were used primarily as winter range by elk.

Survey data for root disease centers on the Coeur d' Alene National Forest showed that an estimated 5.1 percent of the commercial forest area was included in the root disease centers. The greatest number of centers occurred in the western hemlock/pachistima habitat type, while the highest frequency of centers occurred in the grand fir/pachistima and Douglas-fir/ninebark habitat types.

Nursery diseases. Evaluations to determine seedling mortality at the Coeur d'Alene Nursery continued; losses in 2–0 stock were only 3 to 4 percent.

Empirical observations at the St. Regis Paper Company Nursery at Libby, Mont., indicated that seedling losses varied from 40 to 100 percent in individual beds and that losses were probably caused by a number of interacting factors, including excessive herbicide usage, highly alkaline soil conditions, and the improper use of organic materials, which led to a buildup of root pathogens. Laboratory data showed soil *Fusarium* spp. populations of up to 1,600 propagules per gram of soil; *Pythium* spp. may also have been present.

White pine blister rust. The Clearwater National Forest established a western white pine seed production area in the Beech Creek drainage. Approximately 82 percent of the western white pine seedlings planted on the area were killed by the white pine blister fungus, *Cronartium ribicola* J. C. Fisch. The white pines that survived carried a high frequency of genes for resistance to the fungus, and once established should produce seeds highly resistant

to white pine blister rust and well adapted to the elevational zone.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Moreau. The disease was confirmed for the first time in Missoula, Mont., in 1973, from a single American elm tree. One additional tree was also confirmed in 1975; several more trees with typical symptoms died, but the fungus was not recovered.

Dwarf mistletoe. Silvicultural control of dwarf mistletoe was accomplished on 5,068 acres on four National Forests in 1975.

Air pollution. A 330-megawatt, coal-fired steam power plant was operational at Colstrip, Mont., and strip mining and rail transportation of coal were in progress; a second 330-megawatt plant will soon begin operations. A cooperative agreement was set up between the University of Montana and the Forest Service to characterize baseline conditions of the ponderosa pine ecosystems on the Custer National Forest. Ponderosa pine, a major economic factor in the Colstrip area, is one of the species more sensitive to air pollution. Seventeen study plots were established in potentially high-impact areas. Evaluations were made of physical, biological, and chemical characteristics on selected ponderosa pine. This long-term assessment will act as an early-warning system for potential air pollution damage to the trees and understory species on the Custer National Forest.

Other diseases. The Kootenai National Forest reported top-kill in western larch scattered over nearly 300 acres. Examination showed that damage was due to rodent girdling of the main stems in the upper crowns. An accurate estimate of damage could not be made because of fall needle drop, but district people estimated that 10 to 12 trees per acre suffered top-kill.

Needle cast of lodgepole pine, caused by *Lophodermella concolor* (Dear.) Darker, was prevalent this year in the lower Clark Fork River drainage in western Montana and northern Idaho. About 65,000 acres were aerially surveyed, and accessible areas were ground checked. Nearly 9,500 acres were identified with light discoloration and 9,000 acres with heavy discoloration. *Lecanosticta* sp. and *Hypodermella arcuata* Darker were locally severe on western white pine in the Bovill area of north Idaho.

CENTRAL ROCKY MOUNTAINS [3] (R–2)

by

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Conditions in Brief

Old growth stands are the major problem confronting insect and disease management activities in the Central Rocky Mountain region. The limited development of the Region's timber resources has tended to perpetuate the overmature condition of much of the forest. Survey data indicated that for practically all forest types the preponderance of sawtimber volume was in overmature, slow-growing trees.

Insect diseases caused more than 80 percent of the annual mortality. The combined effects of insects and diseases resulted in an annual sawtimber mortality of over 500 MMBF, or nearly twice the annual cut. Growth loss from these agents was not known, but probably exceeded mortality. Diseases were the major contributors to growth loss.

Infestations of the mountain pine bettle continued at high levels in ponderosa pine along the Front Range of Colorado and in the Black Hills of South Dakota and Wyoming. Smaller infestations in ponderosa pine were also scattered on and near the Bighorn Mountains, Wyo. Lesser infestations of the mountain pine beetle in lodgepole pine were present in several areas in the region. Although western spruce budworm activity was generally low, several areas on the Roosevelt National Forest and adjacent lands showed moderate to heavy defoliation. No large spruce beetle infestations were present at this time. The White fir needle miner caused severe defoliation on white fir near La Veta Pass, Colo., and some ornamental plantings of blue spruce in Denver were heavily defoliated by the Douglas-fir tussock moth. Several insects continued to damage pine plantations and shelterbelt plantings in the plains states. Tip moths

[3] The following organizations contributed information for this report: Colorado State Forest Service, South Dakota State Division of Forestry, and the Rocky Mountain Forest and Range Experiment Station.

F–523692

Figure 16.—Adult mountain pine beetle.

and the Zimmerman pine moth were the most destructive of these insects.

Lodgepole pine dwarf mistletoe and Comandra blister rust continued to cause unacceptable losses of lodgepole pine in the region. Cankers and stem rots caused aspen decline and mortality in many recreation sites in Colorado. Oak wilt was detected in two more counties in Kansas and in one county in Nebraska. Dutch elm disease continued to spread in natural stands of elm in rural areas, as well as in urban communities. Black staining root disease was detected in 10 western counties of Colorado on pinyon pine; no disease centers were found east of the Continental Divide. Weather damage was suspected as the major cause of damage to ponderosa pine over several hundred acres of the San Juan National Forest, Colo. Excess nitrogen was suspected as the cause of chlorosis and stunting of lodgepole pine seedlings in one Forest Service nursery.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. Both the Black Hills of South Dakota and Wyoming and the Front Range of Colorado continued to sustain high levels of loss in ponderosa pine from the mountain pine beetle (fig. 16). The predicted insect population is high for both areas.

In the Black Hills, an accelerated program to log beetle-infested trees ran concurrently with an increased timber-sale program to improve stand conditions. The goal of the timber sale program was to reduce basal area in stands that were currently overstocked and to make those stands less susceptible to attack by the mountain pine beetle. Approximately 850,000 trees on 1 million acres were estimated to have been attacked by the 1975 flight of the beetle.

Along the Front Range, over 1 million ponderosa pine were attacked. Vast acreages of overstocked, mature forests infested by dwarf mistletoe (fig. 17) and susceptible to the beetle ensured a continued outbreak.

In Wyoming, mountain pine beetle infestations increased at several locations along the eastern slope of the Bighorn Mountains on State, private, BLM, and National Forest lands.

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Figure 17.—Pines killed by mountain pine beetles on a poor site, exhibiting extensive dwarf mistletoe infection.

At least 6,000 ponderosa pine were infested. Small, active infestations were present on State and BLM lands in scattered ponderosa pine stands near Midwest and Kaycee, Wyo.

Mountain pine beetle infestations were evident in lodgepole pine in several areas of the region. An estimated 12,000 trees in the Middle Park region of Colorado were infested; most of these trees were at the lower elevational range of lodgepole pine. The epidemic on State, private, and Federal lands is several years old. Another infestation near Lander, Wyo., continued on the Shoshone National Forest, BLM, State, and private lands.

Western spruce budworm, *Choristoneura occidentalis* Freeman. While defoliation from this insect was detected over a large area of Colorado, the host species was not a major component of the forest stand, and the damage was not severe. An area of approximately 10,000 acres on the Roosevelt National Forest and adjacent lands, including Rocky Mountain National Park, was moderately to heavily defoliated by this insect.

Spruce beetle, *Dendroctonus rufipennis* (Kirby). Very little spruce beetle activity was present in the region. An infestation on the Rio Grande National Forest consisted of about 2,000 infested trees on 200 acres. Woodpecker activity in this area was very high, and the infestation was not expected to develop further. Three small infestations were present on the Routt, Rio Grande, and San Juan National Forests, but all of these should be eliminated by sale programs.

Douglas-fir tussock moth, *Orgyia pseudotsugata* McD. High-value ornamental Colorado blue spruce were heavily defoliated throughout much of the Denver and Colorado Springs areas. Damage was severe at Lowry Air Force Base.

White fir needle miner, *Epinotia meritana* Heinrich. Defoliation by this insect on white fir near La Veta Pass, Colo., increased to a severe level. Many of the fir were also infested with western spruce budworm. Total area within the infestation is now about 7,000 acres, mostly on private land or BLM land. Some mortality occurred in weakened trees which were attacked by the fir engraver, *Scolytus ventralis* LeC., and additional mortality in standing white fir was likely.

Zimmerman pine moth, *Dioryctria zimmermani* (Grote). This insect caused severe limb and branch damage to Scots pine and Austrian pine in north central Nebraska. Up to 75 percent of the trees in some plantations and shelterbelts were damaged.

Tip moths. The Nantucket pine tip moth, *Rhyacionia frustrana* (Comst.); the western pine tip moth, *Rhyacionia bushnelli* (Busck); and the southwestern pine tip moth, *Rhyacionia neomexicana* Dyar., continued to cause stunting, deformity, and growth loss in young pines throughout most of the region. In the Plains States, the loss was found in shelterbelts and pine plantations. In Colorado, young ponderosa pine along the Front Range were attacked.

Pine tortrix, *Choristoneura lambertiana ponderosana* Obraztsov. Low populations of this insect continued to cause light defoliation of ponderosa pine terminals and laterals in the Roosevelt National Forest, primarily in the St. Vrain and Big Thompson Canyons. There was also light defoliation in the San Juan National Forest.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Activity in commercial size Douglas-fir on BLM land near Douglas Pass in western Colorado decreased. Extensive tree mortality in previous years created a lack of suitable host material, and is expected to cause a decline in the Douglas-fir beetle population in this area in 1976.

Ips beetles. A complex of several insects and diseases caused mortality in ponderosa pine in the San Juan National Forest for several years. The relationship between the various insects and the diseases, which resulted in tree mortality, was not known. The trees attacked by *Ips knausi* Sw. and *Ips pini* Say. were also defoliated by tiger moths, *Halisidota* sp., at the same time. Two diseases, Armillaria root rot and blue stain, *Ceratocystis minor* (Hedg.) Hunt, were found in the dying trees.

Other insects. Minor damage from the lodgepole terminal weevil, *Pissodes terminalis* Hopp., was observed in lodgepole pine, and the pitch nodule moth, *Eucosma sonomana* Kearf., infested ponderosa pine. Feeding by the smaller European elm bark beetle, *Scolytus multistriatus* (Marsh.), continued to spread Dutch elm disease throughout the region. Mortality of

subalpine fir killed by *Dryocetes confusus* Sw. was observed near Steamboat Springs, Colo.

Status of Diseases

Dwarf misteltoe, *Arceuthobium* spp. The most damaging disease in the Rocky Mountain Region is caused by *Arceuthobium americanum* Nutt. ex Engelm. An estimated 50 percent of the commercial lodgepole pine forest in the region is infested with this parasite. Evaluations of the extent and intensity of dwarf mistletoe infestations were conducted on several forests. Over 25,000 acres of lodgepole pine were surveyed during the summer of 1975 in the Red Feather Ranger District, Roosevelt National Forest. Approximately 40 percent of the forested acres surveyed were infested with dwarf mistletoe.

A systematic survey conducted for the Wyoming State Forest Service in a 53-year-old lodgepole pine stand located near Mountain Home, Wyo., indicated that over 91 percent of the trees were infected with dwarf mistletoe. Infected trees per acre averaged 1,008.

Southwestern dwarf mistletoe, *A. vaginatum* subsp. *cryptopodum* (Engelm.) Hawks and Wiens, is the most important disease problem of ponderosa pine in the Rocky Mountain Region (fig. 18). The current outbreak of mountain pine beetle in the Front Range of Colorado stimulated interest in determining the relationship between bark beetles and dwarf mistletoe, which weakens its host and may predispose it to bark beetle attack. An estimated 46 percent of the ponderosa pine in the Front Range is infested with dwarf mistletoe.

Commercial forested acres in Colorado and Wyoming in need of dwarf mistletoe control through timber sales and commercial and precommercial thinning included over 1.2 million acres of lodgepole pine and ponderosa pine. Over 90 percent of this acreage is on lands administered by the Forest Service.

Stem diseases. The second most damaging disease of lodgepole pine in the region is Comandra blister rust, *Cronartium comandrae* Peck. This disease is particularly damaging to pole- and sawtimber-size (5 to 14 inches d.b.h.) trees in northern and western Wyoming, causing spike tops and mortality. Commercial forested acreage in Wyoming infested with the rust is estimated as follows: Bighorn National Forest, 87,000 acres; Medicine Bow National Forest, 91,000 acres; and Shoshone National Forest, 80,000 acres.

In a 1975 evaluation to determine the impact of the disease on timber yield, of 21 stands sampled, rust incidence ranged from 8 to 72 percent; mortality ranged from 0 to 29 percent.

Oak wilt, *Ceratocytis fagacearum* (Bretz) Hunt. Thurston County in northeastern Nebraska was recently found to have red and bur oaks infected with oak wilt. Oak wilt was also newly detected in two counties in Kansas: on red oaks in the northeast, in Jackson County, and on blackjack oaks in the southeast, in Neosho County. The disease appears to have reached a static level in both these States, and although individual infection centers are slowly enlarging, it appears that the disease has reached its ecological limits in this area.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor. This disease continued to cause losses of American elm throughout the Region. Rural spread of the disease among native elm populations along river bottoms resulted in up to 50 percent loss of trees.

Confirmed cases of the disease were not increasing at the geometric rate predicted for most areas in Colorado. Although 3,837 cases were confirmed in 1975, compared to 2,845 cases in 1974, most of this increase was attributed to increased diagnostic effort in the Denver area. In 1975, an effort was made to submit specimens of all symptomatic elms for diagnosis; this effort revealed that 1,296 Denver elms were lost to Dutch elm disease. Eighteen new locations were added this year, most of which were small, outlying communities. The disease occurred in 22 of the 63 Colorado counties.

The Colorado State Forest Service, in cooperation with the Forest Service, Northeast Forest Experimental Station, initiated a beetle-trapping study. Beetle populations were quite low, as indicated by 2,500 pheromone-baited sticky traps.

Black staining root disease, *Verticicladiella wageneri* Kend. This root disease (fig. 19, *A*) was discovered in 10 western counties of Colorado on pinyon pine. Root contacts were implicated in local spread of the disease; bark beetles were also suspected as long range vec-

F–523843

Figure 18.—Male and female plants of the southwestern dwarf mistletoe, *Arceuthobium vaginatum* subsp. *crytopodum*.

tors of the fungus. (fig. 19, *B*) To date, the fungus has not been detected east of the Continental Divide, where Armillaria root rot causes similar appearing disease centers. Black staining root disease was limited to pinyon pine as a host in Colorado, although other susceptible tree species were found within infection centers. Many infection centers (fig. 19, *C*) were approximately 1 acre in size and were slowly enlarging.

The cause of decline and mortality of ponderosa pine on the Pagosa Ranger District, San Juan National Forest, was recently determined by personnel from the Rocky Mountain Forest Experiment Station. *Ips* spp. attacking the bole in midcrown were carrying a blue stain fungus, *Ceratocystis minor* (Hedg.) Hunt, which is pathogenic to ponderosa pine. The fungus spreads within the water-conducting tissues over a 2- to 3-year period, resulting in desiccation of the crown, needle shed, and growth loss. Other *Ips* spp. and secondary insects were noted in affected trees.

Root diseases. Shoestring root rot caused by *Armillaria mellea* Vahl. ex Fr. was common in regenerated lodgepole pine cutovers (up to 25 years old) in Colorado and southern Wyoming. This disease was also a problem in the Black Hills of South Dakota.

The fungus was recently diagnosed as the cause of disease centers (up to 1 acre in size) in pinyon stands near Buena Vista, Pike National Forest, and Poncha Springs, San Isabel National Forest. Additional work is needed to

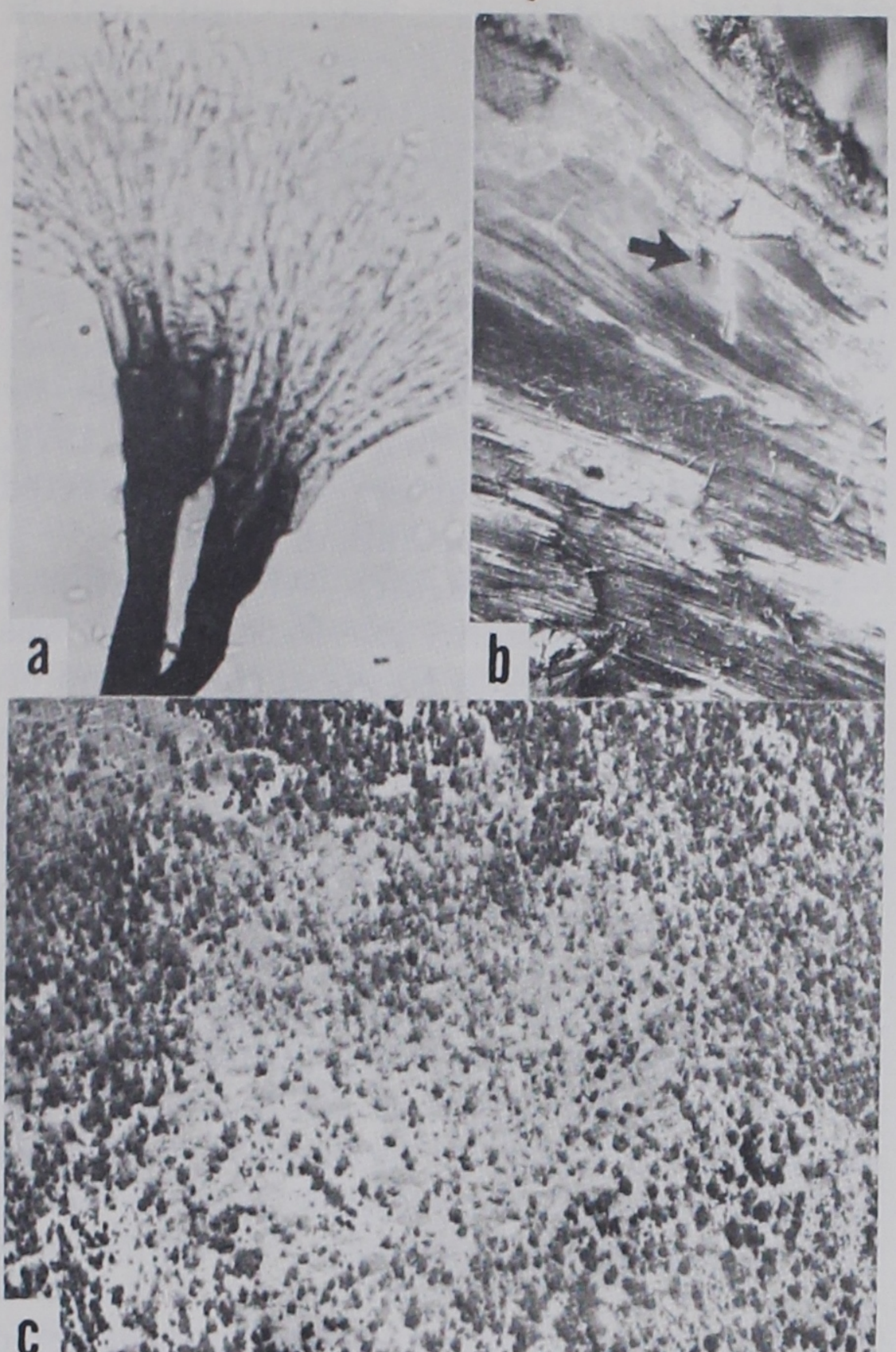

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Figure 19.—*A*, Microscopic characteristics of the root disease fungus *Verticicladiella wagerneri; B*, black staining of the roots and suspected vector of the disease, bark beetles (arrow); beetle gallery is also evident; *C*, aerial view of a disease center—Extensive tree mortality is indicated by the light-colored area in contrast to the darker colored, healthy stand (Colorado).

define the extent and impact of *A. mellea* in this forest type. Other tree species in the Region affected by *A. mellea* include alpine fir, Colorado blue spruce, and Engelmann spruce. No analysis of the impact of the disease on these species is available.

Fomes applanatus (Pers. ex S.F. Gray) Gill. This fungus was common on aspen windthrow. Following a severe windstorm, 86 percent of the recent blowdown in a Colorado aspen stand exhibited signs of *F. applanatus* infection, whereas only 5.2 percent of residual standing trees showed evidence of the fungus.

Weather damage. Several hundred acres of ponderosa pine on a steep south-facing slope on the Mancos Ranger District, San Juan National Forest, exhibited symptoms similar to that caused by "red belt." The red belt syndrome occurs during the winter months when either a temperature inversion or warm chinook winds cause greater loss of moisture from the crown than can be taken outof the frozen soil by the tree.

Most of the 1-year-old and older needles were desiccated and killed, but 1975's foliage and buds were unaffected. Growth loss probably occurred as a result of foliage loss. No tree mortality is expected.

Nursery diseases. Excessive soil nitrogen was implicated as a cause of chlorosis and stunting in lodgepole pine seedlings at the Forest Service, Mt. Sopris Nursery, Carbondale, Colo. Quick-release fertilizers, compounded by heavy, cool soils, resulted in toxic levels of nitrogen in one area of the nursery.

Other diseases. A survey of mycorrhizal fungi native to Colorado was initiated, especially those associated with Engelmann spruce, ponderosa pine, and lodgepole pine. Cultures were attempted on Hagem agar; 30 percent of suspected mycorrhizal fungi showed some growth in cultures, with only a few of these being at all vigorous. Species successfully cultured belonged to the genera *Amanita, Corinarius, Hygrophorus, Laccaria, Lactarius, Rhizopogon, Russula, Suillus, Thelephora, and Tricholoma.*

SOUTHWESTERN STATES (R–3)[4]

by

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Conditions in Brief

Increased moisture during 1975 brought an end to the drought conditions which existed in the Southwestern Region last year. Consequently, drought-associated ponderosa pine mortality decreased, but increased Douglas-fir

[4] Includes all forested lands in Arizona and New Mexico, and National Park Service land in western Texas.

mortality was observed in many areas, possibly a delayed response to the previous year's drought.

The greatest tree losses in the Southwestern Region were caused by bark beetles. A mountain pine beetle infestation on the Kaibab Plateau, Ariz., continued to develop, except on 4,500 acres where suppression logging significantly reduced beetle populations. Spruce beetle infestations that developed on the Fort Apache Indian Reservation, Ariz., and on the Santa Fe National Forest, N. Mex., are expected to intensify next year. A small spruce beetle outbreak on the Coconino National Forest, Ariz., was suppressed by logging infested trees. The roundheaded pine beetle caused considerable mortality to submerchantable ponderosa pines on the Lincoln National Forest and Mescalero-Apache Indian Reservation, N. Mex. The western pine beetle killed scattered mature ponderosa pines throughout the Region. *Ips* beetles caused widely scattered ponderosa pine mortality on marginal sites where stands had heavy dwarf mistletoe.

Defoliators increased noticeably in the Region, but tree damage and losses were minimal. Western budworm populations increased Regionwide and are expected to cause moderate to heavy defoliation in some Douglas-fir and true fir stands next year. Douglas-fir tussock moth infestation caused light to heavy defoliation on the Tonto National Forest, Ariz., on Cibola and Lincoln National Forests, and in Santa Fe, Los Alamos, and Ruidoso, N. Mex. Chronic infestations of the western tent caterpillar continued over the Region and were particularly severe on the Kaibab Plateau, Ariz. Southwestern pine tip moth continued to damage ponderosa pine regeneration on the Chevelon Ranger District, Ariz.

The dwarf mistletoes were the most destructive pathogens in the Region. Preventive and suppressive silvicultural measures against dwarf mistletoes were limited to commercial stands. Acute air pollution injury from sulfur dioxide was observed near copper smelters in New Mexico and Arizona, but tree mortality was not observed.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. An infestation on the Kaibab Plateau, Kaibab National Forest, Ariz., continued in ponderosa pine stands during 1975. Suppression efforts to log infested trees prior to the July beetle flight effectively reduced beetle populations on 4,500 acres. New attacks, however, increased markedly over about 8,000 acres of highly susceptible stands to the south and east of the logged area. A suppression project was initiated in this new outbreak center by logging infested trees prior to July 1, 1976. Scattered infestation centers were also detected in other portions of the Kaibab Plateau.

In northern New Mexico, widely scattered ponderosa pine mortality due to this insect was detected on the Carson National Forest and on private lands around Taos and Chama, N. Mex. This low-level mountain pine beetle infestation has existed for several years, and a similar trend is expected in 1976.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). An infestation covering about 75,000 acres in the Jemez Mountains, Santa Fe National Forest, N. Mex., was detected during aerial surveys. Scattered spruce blowdown triggered the infestation, perhaps with logging activity a contributing factor in some areas. The infestation is expected to intensify next year.

Renewed spruce beetle activity was detected from the air in portions of the White Mountains, Fort Apache Indian Reservation, Ariz. Infestation centers were located in drainages where a recent outbreak (1968–73) caused light tree mortality. There were enough susceptible trees present to support a renewed outbreak.

A small outbreak of spruce beetle in the San Francisco Peaks, Coconino National Forest, Ariz., was suppressed by logging infested trees and treating stumps. This infestation originally developed in avalanche-damaged spruce. An area of infested spruce blowdown, concentrated in the Arizona Snow Bowl of the Peaks, also threatens surrounding stands in this high-use ski area.

An evaluation of the impact of spruce beetle infestations on timber resources was fully implemented during 1975. Permanent plots were sampled on two 300-acre survey tracts where spruce beetles caused substantial tree losses during recent years, and on one 300-acre tract with a high infestation level. The first two

tracts, one in the Mt. Baldy Wilderness, Apache-Sitgreaves National Forest, and one in the White Mountain Apache Tribal Wilderness, Ft. Apache Indian Reservation, Ariz., had losses totaling 16 and 10 spruce trees per acre, respectively. The third tract, in the San Pedro Parks Wilderness, Santa Fe National Forest, had total spruce losses of 4.5 trees per acre, but the infestation was increasing.

Roundheaded pine beetle, *Dendroctonus adjunctus* Blandf. This insect continued to cause considerable ponderosa pine mortality in the Sacramento Mountains of the Lincoln National Forest, on the Mescalero-Apache Indian Reservation, and on intermingled non-Federal lands in southern New Mexico. Much of the tree mortality was in submerchantable-size stands. There appeared to be a direct association between tree susceptibility and site, stand density, drought stress, and dwarf mistletoe infection.

Western pine beetle, *Dendroctonus brevicomis* LeC. Widely scattered mature ponderosa pines were killed by this beetle throughout portions of the Apache-Sitgreaves, Coconino, Coronado, Prescott, and Tonto National Forests, Ariz., and the Cibola, Gila, and Lincoln National Forests, N. Mex.

Southern pine beetle, *Dendroctonus frontalis* Zimm. This beetle caused mortality to scattered Chihuahua and ponderosa pines in the Santa Catalina Mountains, Coronado National Forest, Ariz. About 125 MBF of beetle-killed trees were salvaged in 1974 and 1975.

Ips beetles, *Ips* spp. Ponderosa pine losses in the Southwest from several species of ips beetles decreased from 1974 levels. No large epicenters of mortality were observed. Scattered tree losses were detected throughout the ponderosa pine forest type in Arizona and New Mexico. Most of the tree mortality occurred on marginal growing sites for ponderosa pine where stands were heavily infested with dwarf mistletoe.

Often, when management activities (i.e., logging or timber stand improvement) are conducted in stands growing on marginal sites, resident ips populations can build up in the slash and threaten nearby trees. This situation occurred on the Walnut Creek Ranger District, Prescott National Forest, Ariz., where slash was infested with *Ips lecontei* Sw.

Western spruce budworm, *Choristoneura occidentalis* Freeman. Increased budworm activity was detected in the Region during 1975. Defoliation of Douglas-fir and true firs, as estimated during aerial surveys, totaled 9,843 acres (6,760 acres lightly defoliated, 2,381 acres moderately defoliated, and 702 acres heavily defoliated). Host trees were defoliated on portions of the Kaibab Plateau, Kaibab National Forest, Ariz., and on the Carson, Santa Fe, Cibola, and Gila National Forests and the Philmont Boy Scout Ranch, N. Mex. The 1975 egg mass survey indicated that populations will increase during 1976 in these areas and cause moderate defoliation to host trees. Heavy defoliation can be expected in a few local areas.

Douglas-fir tussock moth, *Orgyia pseudotsugata* McD. Defoliation of Douglas-fir and true firs was found in the Region during 1975. Heavy defoliation over approximately 50 acres occurred in the Manzano Mountains, Cibola National Forest, near Albuquerque, N. Mex. Low-level outbreaks were detected on the Lincoln National Forest in southern New Mexico and on the Tonto National Forest in central Arizona. Chronic infestations continued in ornamentals (mainly spruce) in Santa Fe, Los Alamos, and Ruidoso, N. Mex.

A survey was conducted with traps baited with sex pheromone to determine more accurately the geographic distribution of the tussock moth in the Southwest. Results showed that this insect occurred in mixed coniferous forests of central and north central Arizona and throughout most of New Mexico.

Western tent caterpillar, *Malacosoma californicum* (Pack.). Localized infestations of this moth were detected in aspen stands throughout the Southwest, but extensive defoliation was detected only in a few locations. Tent caterpillars caused severe defoliation in Arizona on the Kaibab Plateau, Kaibab National Forest; on Navajo Mountain, Navajo Indian Reservation; on the Coconino National Forest, near Mormon Lake; and in the Pinaleno Mountains, Coronado National Forest; and in New Mexico in the Black Range, Gila National Forest. Most trees, however, refoliated during late summer, although some branch mortality was observed on the Kaibab Plateau where an infestation has been epidemic for several years.

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Figure 20.—Types of southwestern pine tip moth damage to ponderosa pine reproduction: *A*, Posthorn; *B*, lateral pruning; *C*, spiketop; *D*, no damage; *E*, crook; *F*, fork; *G*, bush.

Southwestern pine tip moth, *Rhyacionia neomexicana* (Dyar). This insect continued to damage ponderosa pine reproduction (fig. 20) on the Apache-Sitgreaves National Forest, Ariz., in 1975. Major infestations of the tip moth have persisted on the Chevelon Ranger

District over 26,000 acres of regenerated burns since 1967.

In cooperation with the Rocky Mountain Forest and Range Experiment Station, Region personnel are analyzing pine tip moth damage to the ponderosa pine resource (fig. 20). The most common types of damage were lateral pruning, crook, and bush, which comprised about 60 percent of the 5,000 internodes sampled. Data on individual tree height growth and infestation level, gathered since 1967, are being correlated with the deformity produced by destruction of lateral and terminal branches and buds.

Other insects. The large aspen tortrix, *Choristoneura conflictana* (Wlk.), severely defoliated aspen stands on parts of the Kaibab Plateau, Ariz., for the third successive year. A geometrid, probably the New Mexico fir looper, *Galenara consimilis* Hein., in association with the western spruce budworm and Douglas-fir tussock moth, contributed to severe defoliation of Douglas-fir and true firs over about 6,000 acres on the Lincoln National Forest, N. Mex. The smaller European elm bark beetle, *Scolytus multistriatus* (Marsh.), was detected throughout New Mexico and in Arizona for the first time by using synthetic pheromone traps.

Status of Diseases

Dwarf mistletoe, *Arceuthobium* spp. This continued as the most destructive disease agent in the Southwest. Southwestern dwarf mistletoe, *Arceuthobium vaginatum* subsp. *cryptopodum* (Engelm.) Hawks. and Wiens, on ponderosa pine, and Douglas-fir dwarf mistletoe, *Arceuthobium douglasii* Engelm., again exerted the greatest economic impact in commercial timber stands of the Southwest. Silvicultural treatments to reduce the impact of these parasitic plants continue. Emphasis has been placed on preventive silvicultural treatment of mistletoe in order to avoid creation of "untreatable" mistletoe-infested stands.

Air pollution. Acute sulfur dioxide injury to forest vegetation from copper smelter emissions was observed on the Apache-Sitgreaves National Forest, near Morenci, Ariz., and on the Tonto National Forest, near Miami, Ariz. As in previous years, neither trees nor minor vegetation has been killed by sulfur dioxide fumigation. Acute sulfur dioxide injury was limited to tipburn on conifers and interveinal bleaching and browning on broadleaf plants. Fewer plant species were injured in 1975 than in previous years, probably because sulfur dioxide emissions decreased as copper production dropped in response to a slumping economy.

Aspen diseases. Pathogens caused defect and cull to residual aspen following selective logging on the Carson National Forest, N. Mex.

Rusts. Limb rust, *Peridermium filamentosum* Pk., remained at a low level in ponderosa pine forests of the Southwest.

Spruce broom rust, *Chrysomyxa arctostaphyli* Diet., and fir broom rust, *Melampsorella caryophyllacearum* Schroet., caused spiketops and bole deformation in many areas of the Region. Fir broom rust of white fir has been prevalent on portions of the Cibola National Forest for many years. Management of this disease has been hindered because of constraints on removing infected trees that are of value for recreation and wildlife uses.

Foliage diseases. These diseases remained static throughout the Southwestern Region in 1975. Several reports of *Elytroderma deformans* (Weir) Dark. on ponderosa pine were received from northern Arizona. *Lirula abietis-concoloris* (Mayr ex Dearn.) Dark. was detected on white fir in limited areas of northern New Mexico.

An unidentified foliage disease, characterized by browning and curling of portions of the new growth, occurred in scattered locations throughout the Region. Douglas-fir, white fir, corkbark fir, Engelmann spruce, and blue spruce all exhibited these characteristic symptoms, generally early in the growing season, but little exidence of injury remained by late summer. Observation of this disease will continue in 1976.

Stem canker, *Cytospora chrysosperma* (Pers.) F. This disease was encountered frequently on cottonwood in Big Bend National Park, Tex. A program to reduce the impact of the disease on cottonwoods in the park was developed and implemented.

Root disease, *Armillaria mellea* Vahl. ex Fr. This caused some ponderosa pine seedling and sapling mortality in portions of Ari-

zona. Regionwide, this root rot continued to be endemic, often functioning as a natural thinning agent. A pine plantation that sustained 2 to 7 percent tree mortality during 1971 and 1972 was found to be free of the root rot this year. Tree maturation and increased vigor may be responsible for the decline of *A. mellea* on the plantation.

Trunk and butt rot, *Echinodontium tinctorium* (E. & E.) E. & E. This disease was frequently detected in mature to overmature white fir stands throughout the Region. Timely harvest of mixed conifer stands is essential to reduce volume losses caused by this fungus. Volume losses attributed to trunk and butt rot of ponderosa pine sawtimber are being evaluated in various portions of the Region.

Drought stress. There was less ponderosa pine mortality this year than last, which could be associated with drought stress, concomitant with dwarf mistletoe infection and/or secondary bark beetles. This type of mortality decreased because moisture conditions improved in most portions of the Region in 1975. An increase in Douglas-fir mortality, however, was observed in submerchantable-size stands throughout the Region. Secondary insects were found in some of the dying trees, but it appeared that much of the observed tree mortality was a delayed response to the 1973–1974 drought conditions. Douglas-fir mortality was particularly severe on the Apache-Sitgreaves, Coconino, Kaibab, and Prescott National Forests, Ariz., and on the Gila and Lincoln National Forests and Mescalero-Apache Indian Reservation, N. Mex.

Road deicing salt. Chloride toxicity continued to affect roadside trees on the Cibola and Santa Fe National Forests, N. Mex. On the Cibola National Forest, salt affected primarily white fir, corkbark fir, and Engelmann spruce. Tree mortality on the Cibola National Forest was less during 1975 than the previous year because less deicing salt was applied to highways. White fir and aspen were the primary tree species damaged by deicing salt on the Santa Fe National Forest.

Hail damage. A hailstorm caused severe defoliation of ponderosa pine over about 100 acres of the Jemez Ranger District, Santa Fe National Forest, N. Mex. Defoliation, wounding of twigs and branches, and terminal leader mortality were prevalent on affected trees. Reexamination of the area in late 1975 indicated that tree mortality resulting from hail damage was very limited.

SOUTHERN AND SOUTHEASTERN [5] STATES (R–8)

Forest Insect and Disease Management
State and Private Forestry
Atlanta, Ga.

Conditions in Brief

The southern pine beetle continued to be the most damaging forest insect in the South. The outbreak, which included all 13 Southern States, with Kentucky and Oklahoma reporting the problem for the first time, covered over 44 million acres of State and private lands and about 2.7 million acres of Federal land. An estimated 273.5 MMBF of sawtimber and 64.4 million cubic feet of pulpwood were harvested in the outbreak areas.

Southern pine beetle populations declined throughout most of the Atlantic Coastal Plain and in scattered areas of the Piedmont Plateau. Populations remained high, however, in much of the Appalachian Mountains and generally moderate in the Piedmont Plateau. Populations were increasing in Texas but were generally down in Alabama and Louisiana.

Defoliator activity increased during 1975. Defoliation from oak sawflies increased substantially, covering over 3 million acres in Kentucky and Virginia. Fortunately, no tree mortality was reported. The fall cankerworm continued to be active in Georgia, North Carolina, and Virginia. Forest tent caterpillar infestations decreased from 500,000 acres to 200,000 acres in Louisiana, but increased in Alabama and South Carolina. The oak leaf tier defoliated over 43,000 acres in Virginia.

Seed orchard insects, particularly coneworms and the Nantucket pine tip moth, continued as the major pests threatening the tree improvement program.

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[5] Includes forested lands in Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

The disease receiving the greatest attention in 1975 was fusiform rust. Over 1,000 lots of improved pine seed were tested for resistance to fusiform rust at the Forest Insect and Disease Management Disease Resistance Testing Center near Asheville, N.C. In a continuing evaluation of fusiform rust impact in south Louisiana, annual mortality was 12 percent in 11-year-old plantations and 8 percent in 6-year-old plantations. Some fusiform rust was reported in nurseries in spite of protective spray programs.

Scattered reports of *Fomes annosus* damage on plantations and seed orchards were received.

Pitch canker continued to cause damage in slash pine plantations in northern Florida. This disease was also reported in some seed orchards in the Southeast.

Various root, stem, and foliage diseases continued to be a problem in softwood and hardwood nurseries. Cylindrocladium root rot caused mortality in black walnut and yellow poplar nursery seedbeds in three States. *Pythium* spp. damaged about 1 million 2–0 white pine seedlings in one nursery, and high rainfall caused seed loss and seedling damage in several other nurseries. Foliage diseases, including a white pine foliage disease and juniper blight, also caused damage in some nurseries.

Oak mortality of unknown cause was reported in portions of five States. Most of the affected trees were in pastures and yards.

Status of Insects

Southern pine beetle, *Dendroctonus frontalis* Zimm. Southern pine beetle activity in Alabama decreased substantially, with most activity occurring in the northern portion of the State. The number of counties infested with southern pine beetle dropped from 49 in 1974 to 29 in 1975. During 1975, 10.5 MMBF plus 3.4 million cubic feet of timber infested with southern pine beetle were harvested from State, Federal, and private lands.

In Arkansas, southern pine beetle activity remained low to moderate in the four previously infested counties; however, isolated spots were reported in four new counties. A total of 641 MBF and 284 thousand cubic feet of timber infested with southern pine beetle was harvested from State and private lands in 1975.

In Georgia, population levels remained high in mountain areas of the northern portion of the State, but declined in the Central Piedmont and Coastal Plain. Over 9 million acres of host type were included in the outbreak area. Suppression projects were conducted by the Georgia Forestry Commission, the Chattahoochee, and Oconee National Forests, the U.S. Army Corps of Engineers at Lake Allatoona, and, to a limited extent, the Chickamauga and Chattanooga National Military Park. Over 7.2 MMBF of sawtimber and 3.4 million cubic feet of pulpwood were salvaged in 1975.

The first officially recorded outbreak of southern pine beetle in Kentucky was discovered in March 1975. By the end of the year, the infestation occurred in six counties in the southeastern portion of the State.

The southern pine beetle population continued to decline in Louisiana. In the northern and central portions of the State, activity remained low, although activity increased during the fall. Moderate infestations occurred in southern Louisiana, with Allen and Evangeline Parishes reporting the most activity. A total of 3.6 MMBF of sawtimber and 492.7 thousand cubic feet of pulpwood was harvested on State, Federal, and private lands in 1975.

In western Florida, the infestation on Eglin Air Force Base intensified. First discovered in 1974, it is the only one present in Florida. More than 150.2 thousand cubic feet of pulpwood were salvaged from July through December.

In Mississippi, activity declined in the southwestern part of the State, although high populations still occurred in the northeastern corner of the State in midsummer. During 1975, 4.6 MMBF of sawtimber and 27.9 thousand cubic feet of pulpwood were harvested on State, Federal, and private lands.

For the first time in nearly 50 years, southern pine beetle was reported in Oklahoma. An aerial survey of the Tiak Ranger District of the Ouachita National Forest revealed a significant number of southern pine beetle spots in early September. An aggressive control project was initiated, and by the end of the year, 137 MBF and 8,300 cubic feet of timber infested by southern pine beetle had been salvaged on Federal land.

Very few active southern pine beetle spots

remained on the Coastal Plain of North Carolina, but the problem was severe in the mountains and in portions of the Piedmont. The area affected over 9 million acres. In 1975, over 74.2 MMBF of sawtimber and 14.4 million cubic feet of pulpwood were salvaged from State, private, and Federal lands.

Although infestations occurred on over 3½ million acres in South Carolina, the outbreak declined sharply over most of the State. More than 10.3 MMBF of sawtimber and 6.24 million cubic feet of pulpwood were salvaged on State, Federal, and private lands in 1975.

Southern pine beetle activity remained low in spring and early summer in Texas, then increased to moderate or high levels in the fall. One-third of the activity in Texas occurred in the southeastern portion of the outbreak area. An estimated 61.2 MMBF of sawtimber and 4.6 million cubic feet of pulpwood were salvaged in 1975 on State, Federal and private lands.

Southern pine beetle populations continued at high levels in eastern Tennessee, and infestations were found as far west as Hardin county in the south central section of the State. Over 1½ million acres of host type were in the outbreak area. The Cherokee National Forest and the Energy Research and Development Administration, Oak Ridge Reservation, conducted suppression projects. A total of 5.6 MMBF of sawtimber and 2.2 million cubic feet of pulpwood was harvested in 1975.

Southern pine beetle populations in Virginia were low to moderate on the Coastal Plain and south central Piedmont, and remained relatively low in the central Piedmont. Populations were relatively high on two National Forest Districts in the Blue Ridge Mountains. About 2¼ million acres of host type were in the outbreak area. An estimated 39 MMBF of sawtimber and 13.6 million cubic feet of pulpwood were from State, Federal, and private lands.

Ips engraver beetles, *Ips* spp. These pests occurred in scattered single and small multiple tree spots throughout the Southern States. Static conditions continued in most areas, with higher levels in Arkansas and eastern Texas. Some localized outbreaks occurred around tornado-damaged timber in central Louisiana and on the Osceola National Forest in Florida.

Black turpentine beetle, *Dendroctonus terebrans* (Oliv.) Populations in Texas, Alabama, Arkansas, Mississippi, and Louisiana remained static, with scattered attacks in single or small, multiple-tree spots. Localized, large outbreaks occurred in the Chickasawhay District on the DeSoto National Forest, Miss. Turpentine beetles in combination with ips were found killing a substantial number of pine in the southern part of the Daniel Boone National Forest, Ky.

Forest tent caterpillar, *Malacosoma disstria* Hbn. Forest tent caterpillar defoliation on water tupelo in Louisiana occurred on a known 104,000 acres, with an estimated total and partial defoliation occurring on another 93,000 acres. This represents about a 60-percent decrease over 1974 in affected area. Severe to partial defoliation occurred on 75,000 acres of the Mobile Basin swamp, Ala. Populations were so high in some areas that caterpillars were found in sweetgum on normally uninfested surrounding areas.

This pest was also detected in Dorchester County, S.C., during May 1974. The insect caused scattered defoliation of tupelo gum, black gum, sweet gum, and other broad leaf trees on a 6,600-acre area. The infestation expanded in 1975, causing defoliation over 25,000 acres in Dorchester and Charleston Counties.

Fall cankerworm, *Alsophila pometaria* (Harr.). Cankerworm was again active during 1975 in three of the Southeastern States—Georgia, North Carolina, and Virginia. Four new outbreaks were detected on four Ranger Districts of the Chattahoochee National Forest, Ga. An aerial survey in June delineated the outbreak into four areas of defoliation, located at the higher elevations of the area. Four outbreaks of moderately heavy defoliation covered approximately 22,300 acres of the forest and intermingled State and private lands (fig. 21).

In North Carolina, the cankerworm continued to increase on or near the Coweeta Experimental Forest in two separate watersheds. On the Wayah and Tusquittee Ranger Districts of the Nantahala Forest, seven separate areas of light to heavy defoliation were detected during an early June aerial survey. The total outbreak area covered approximately 9,000 acres.

The Virginia outbreak of the fall cankerworm declined considerably in 1975. A survey con-

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Figure 21.—Fall cankerworm defoliation on hardwoods in north Georgia.

ducted in June by the Virginia Division of Forestry indicated marked reductions in Skyland and Clarke Counties. Actual survey data showed 80 acres of moderate defoliation at Bull Run (Prince William County); 50 acres of moderate defoliation in Clarke County; and 10 acres of moderate and 40 acres of light defoliation at Skyland.

A spray project conducted on 500 acres at the Bull Run Mountain Estates reduced the cankerworm population by 50 percent or more. A survey indicated that populations were also declining outside the spray area.

Oak leaftier, *Croesia albicomana* (Clem.). The oak leaftier was active in Virginia and affected approximately 43,750 acres of State, Federal, and private lands. Defoliation ranged from 20 to 50 percent and was scattered throughout the area.

The hemlock woolly aphid, *Adelges tsugae.* The hemlock woolly aphid, a native insect pest in the east, caused some concern as an ornamental problem. It was discovered in native eastern hemlock last year in Franklin County, Va.; its impact was not known. The Virginia Division of Forestry plans to evaluate its effect on infested stands of native hemlock.

Green spruce aphid, *Cinara fornacula* Hottes. The green spruce aphid caused major concern in and around Asheville, N.C., in early summer 1975. The insect defoliated the older needles of many ornamental red and Norway spruces. Native stands of red spruce at higher elevations were not affected.

Balsam woolly aphid, *Adelges piceae* (Ratz.). The balsam woolly aphid continued to cause mortality in the Fraser fir stands of the southern Appalachian Mountains. New infestations discovered in 1974 in the Great Smoky Mountains National Park near Newfound Gap, along the Blue Ridge Parkway between Mount Pisgah and Waynesville, and on Roan Mountain continued to increase during 1975. Suppression activities were conducted in designated protection areas on the Mount Mitchell State Park and in the Toecane Ranger District of the Pisgah National Forest during 1975. The Fraser fir stands on Mount Rogers, Va., continued to be the only area of this particular fir type where the aphid had not been detected.

Sluglike oak sawfly, *Caliroa* sp. A sluglike sawfly infesting red and white oaks in southeastern and central Kentucky increased dramatically in 1975, infesting approximately 2,300,000 acres this year. A cooperative Kentucky Division of Forestry and Forest Service aerial survey revealed 1,200,000 acres of light to moderate damage; 1,000,000 acres of heavy damage; and 100,000 acres of extremely heavy damage. This particular insect causes skeletonization of the leaf but not complete defoliation. No tree mortality was reported.

The Oak Sawfly *Caliroa* (near) *quercuscoccineae* Dyar and *Caliro sp.* This sawfly and other sawflies were detected in western and southwestern Virginia. Approximately 1 million acres were affected. These insects were reported feeding on red, white, and chestnut oak.

Coneworms, *Dioryctria* sp. Coneworm damage in 1975 to first-year pine conelets at the Stuart Orchard, La.; was 27 percent on slash,

15 percent on longleaf, 12.0 percent on loblolly, and 3 percent on shortleaf. Losses to second-year cones on untreated shortleaf pines at the Stuart Orchard averaged 7 percent. A 2-year impact study (1974–75) indicated that coneworm damage on shortleaf pine at the Ouachita Orchard, Ark., was 5 percent of the total cone crop. Second-year cone loss due to coneworms at the Erambert Orchard, Miss., averaged 1.3 percent on loblolly pines and 9.0 percent on longleaf pines. A survey on the Francis Marion Seed Orchard, S.C., indicated that only 3.2 percent of second-year cones were attacked by coneworms.

Nantucket pine tip moth, *Rhyacionia frustrana* (Comstock). The Nantucket pine tip moth continued to be a problem on the Stuart Orchard, La., and on the Ouachita Orchard, Ark. An impact evaluation initiated on shortleaf pines at the Ouachita Orchard in February 1974 and completed in October 1975 showed that 45 percent of the total potential cone crop (first and second year) was destroyed by tip moths. A similar evaluation was made on shortleaf in the same orchard during 1975.

Pine needle midge, *Contarinia* sp. Approximately 17 percent of the loblolly pines at the Erambert Orchard suffered medium to heavy defoliation and dieback because of a needle midge, *Contarinia* sp., during 1974. During 1975, however, populations of the midge were light, and trees showing damage in 1974 had completely recovered. This midge also caused considerable dieback to certain cones in a 15-year-old loblolly pine seed orchard at McNair, Miss., during 1975.

Pine seed bugs, *Leptoglossus corculus* (Say); *Tetrya bipunctata* (H.–S.). Seed bugs were reported in high numbers on shortleaf and loblolly pine conelets and cones on the Stuart, Erambert, and Ouachita Seed Orchards. In addition, large populations of seed bugs were evident at cone harvest time on the Beech Creek Seed Orchard and Edwards State Seed Orchard, N.C.; and on the Francis Marion Seed Orchard, S.C.

White pine cone beetle, *Conopthorus coniperda* (Schwarz). Damage occurred on the Beech Creek Seed Orchard and on the Edwards State Seed Orchard. A survey at the Beech Creek Seed Orchard indicated that the damage was severe and resulted in a loss of about 27 bushels of second-year white pine cones.

Other insects. At Edwards State Seed Orchard, pine coneborers, *Eucosma* spp., were a serious problem on Virginia pine, and a pitch moth, *Petrova comstockiana* (Fern.), was attacking the twigs of pitch pine. Additional losses of white pine cones were caused by the white pine coneborer, *Eucosma tocullionana* Heinrich. This insect was responsible for the loss of 11 bushels of cones at the Beech Creek Seed Orchard.

Status of Diseases

Fusiform rust, *Cronartium fusiforme* (A and K) Hedge. and Hunt. Operational testing of improved slash and loblolly pine seed for resistance to fusiform rust continued at the Forest Insect and Disease Management Fusiform Rust Testing Center near Asheville, N.C. The number of seed lots tested increased to over 1,000 in 1975.

In a continuing evaluation of fusiform rust impact, observations were taken in 1-, 2-, 3-, 4-, 6-, 11-, and 16-year-old slash pine plantations in Louisiana. Of all trees examined in 1975, 32 percent had stem galls, and an additional 20 percent had branch galls within 15 inches of the stem. Stem galls were most numerous in 16-year-old plantations (44 percent) and branch galls were most numerous in 4-year-old plantations (40 percent). About 6 percent of the trees examined died from rust, and about 4 percent died from other causes. Mortality from rust was greatest in 6-year-old (8.5 percent) and 11-year-old plantations (12.3 percent). Rust mortality in both of these age classes increased 4.1 percent over 1974. As in 1974, the largest number of healthy trees (52 percent) occurred in 2-year-old plantations. Most of the infections in 1-year-old plantations were of nursery origin.

Two 11-year-old plantations were particularly hard hit with rust mortality: the number of trees dead from rust increased 6 and 8 percent over 1974 and trees with stem cankers, nonmerchantable trees affected with rust, and trees dead from rust accounted for 56 and 57 percent of the total.

Visits to nurseries in Louisiana revealed infected loblolly and slash pine seedlings as

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Figure 22.—Thinning *Fomes annosus* impact plot with mechanical harvester in Mississippi.

F–700011

Figure 23.—Applying borax to stump on check plot of *Fomes annosus* impact evaluation in Mississippi.

early as August 28 and September 16. Sample plots taken by Weyerhaeuser personnel at Aliceville, Ala., revealed infection levels ranging from 4 to 17 percent in loblolly pine.

Annosus root rot, *Fomes annosus* (Fr.) Cke. A recent evaluation of a 4-year-old white pine plantation established on a clearcut site in the mountains of western North Carolina showed approximately 13 percent *F. annosus* infection and 7 percent mortality. In addition, approximately 50 percent of the residual white pine stumps bore *F. annosus* sporophores. *F. annosus* infection and mortality continued to increase, but at a reduced rate, in the Hiwassee Land Company loblolly pine seed orchard in eastern Tennessee.

In 1975, *F. annosus* impact-evaluation plots were established in six newly thinned pine plantations in Mississippi (figs. 22 and 23). The plots will be examined annually to determine loss due to the disease.

Pitch canker, *Fusarium lateritium f. sp. pini* Hepting. This disease continued to cause serious terminal damage and scattered mortality in slash pine plantations in northern Florida. Surveys conducted by the Florida Division of Forestry and several pulp and paper companies revealed moderate to severe disease incidence (30 percent to 40 percent in many plantations) over approximately 300,000 acres in three north Florida counties. Pitch cankers also caused notable damage to several southeastern slash and loblolly pine seed orchards.

White pine blister rust, *Cronartium ribicola* Fischer. White pine blister rust-control work was limited during 1975 to white pine plantations and to Christmas tree plantings in high rust-hazard areas in the mountains of western Virginia and northwestern North Carolina. The Virginia Division of Forestry conducted ribes eradication control work in a white pine plantation, and the North Carolina Division of

Forestry conducted preplanting site examinations and control work in white pine plantings. The control project on the Shenandoah National Park was terminated this year after over 30 years of annual ribes eradications. No additional control work was conducted on Federal land during 1975. Future white pine blister rust control work will be conducted on a project basis and will be limited primarily to plantations and other high-value white pine resources in high rust-hazard areas.

Oak wilt, *Ceratocystis fagacearum* (Bretz) Hunt. No change in the distribution of oak wilt was reported in the Southern and Southeastern States in 1975. The reported distribution of this disease included portions of Arkansas, Kentucky, Oklahoma, North Carolina, South Carolina, Tennessee, Texas, and Virginia. Almost all oak wilt annual surveys have been terminated for the first time in about 20 years. The Virginia Division of Forestry conducted the single survey in 1975 on a limited basis in two Virginia counties. Disease incidence had not increased from the previous year. Future State surveys to follow the trend of this potentially hazardous disease are planned for 5-year intervals. No control work was done in 1975.

Comandra blister rust, *Cronartium comandrae* Peck. Comandra blister rust continued to cause mortality in young loblolly pine plantations on and adjacent to the Cumberland Plateau in eastern Tennessee, and in young shortleaf pine plantations and natural stands in northern Arkansas. With the exception of the one localized loblolly pine plantation infected with *C. comandrae* in extreme northwestern Kentucky (Crittenden County), the known distribution of the disease in the South is still eastern Tennessee and northern Arkansas.

Nursery diseases. Root rots, *Cylindrocladium scoparium, C. floridanum, Phytophthora* spp., *Pythium* spp., *Sclerotium bataticola–Fusarium* spp., and *Sclerotium rolfsii,* caused locally severe and widespread damage to a number of conifer and hardwood species in southeastern forest tree nurseries during 1975. Cylindrocladium root rot, caused by *C. scoparium* and *C. floridanum,* continued to cause mortality in black walnut and yellow-poplar seedbeds in North Carolina, South Carolina, and Mississippi. Fourth-year data from a black walnut outplanting in eastern North Carolina continued to show correlation of *Cylindrocladium* root rot severity and seedling size at planting date with subsequent field survival. A similar yellow-poplar outplanting in western Tennessee, however, showed no significant survival differences among seedlings with various degrees of root rot severity at planting date after 3 years in the field.

Several *Phytophthora* spp. continued to cause localized severe mortality of Fraser fir seedlings in one nursery and in Christmas tree plantings in the mountains of western North Carolina.

Several *Pythium* spp. were isolated from severely stunted and chlorotic 2–0 and 1–0 white pine seedlings in a western Tennessee nursery. Approximately 1 million 2–0 white pine were rendered unsaleable by the disease this year. Tests are being conducted to develop effective and practical control treatments for this root disease problem.

Black root rot, caused by the *Schlerotium bataticola–Fusarium* spp. complex, continued to cause localized severe damage to 1–0 slash and loblolly pine seedlings in several southeastern nurseries.

Southern blight, caused by *Sclerotium rolsfii,* again severely damaged the 1–0 bicolor lespedeza crop at the Page Nursery, Ga., in 1975.

With the possible exception of fusiform rust, diseases appeared to be at a low level in Gulf States nurseries. Much damage occurred with the washing of seed from beds during periods of high rainfall in the spring and summer. High rainfall also stunted seedlings in many nurseries. The W.W. Ashe Nursery, Miss., received approximately 80 inches of rainfall by mid-September. Many pine seedlings were dwarfed and chlorotic, and seed had been washed from the beds.

An August visit to the Baucum State Forest Nursery near Little Rock, Ark., revealed a low level of root rot in the walnut beds. Only 2,000 walnut trees were lost this year, as opposed to 40,000 lost in 1974. A *Fusarium* sp. has been most frequently associated with this problem. No *Cylindrocladium* spp. were isolated.

Although dwarfing and chlorosis of pine seedlings were observed in nurseries in Louisiana, Mississippi, and Alabama, neither the black root rot organisms nor *Phytophthora*

spp. were isolated. Much of the damage observed may have resulted from too much rain.

Foliage diseases, *Lophodermium* spp., *Scirrhia acicola, Pestalotia* sp., and *Phomopsis* spp., continued to cause widespread damage in southeastern nurseries during 1975. A white pine foliage disease on 2–0 white pine seedlings, similar to that previously reported in North Carolina, South Carolina, and Tennessee, damaged 2–0 white pine seedlings in a Kentucky State Nursery. Laboratory examinations and culturing of symptomatic needles again revealed a *Pestalotia* sp. as the most consistently associated fungus organism. Needle casts and blights, caused by *Lophodermium* spp. and *Scirrhia acicola,* caused localized severe damage to 1–0 scotch and longleaf pines in North Carolina, South Carolina, and Georgia nurseries. Juniper blight, caused by *Phomopsis* spp., damaged eastern red cedar and Arizona cypress wherever these two conifer seedling species were grown. This disease attacked an estimated 10,000 Arizona cypress seedlings being grown for grafting stocks at the Auburn State Forest Nursery, Ala.

Atmospheric pollutants. Little change in the amount of pollution-caused injury to forest vegetation was noted in 1975. A decline in injury to superior pine clones at the Beech Creek Federal Seed Orchard in North Carolina was evident this year as in 1974.

Other diseases. Oak mortality of unknown cause was reported in portions of Alabama, Arkansas, Louisiana, Mississippi, and Texas. The greatest amount of mortality apparently occurred in southern Arkansas. There (as well as in the other States) most of the affected trees were in disturbed areas, such as pastures and yards. Trees were usually affected singly, rather than in groups. Species included southern red, post, white, and willow oaks (fig. 24). Dead foliage was typically persistent, except on post oak on the National Forests of Texas, where dead foliage fell rapidly and some vascular discoloration occurred. Two fungi were isolated from affected trees in Arkansas: a *Cephalosporium* sp. and a *Gloeosporium* sp. Neither fungus was isolated consistently. Their pathogenicity was not determined. More than usual rainfall occurred in much of the affected area during the past 2 years, but the possible effect of this on the trees was not known.

Terminal and branch dieback occurred in some slash, loblolly, and shortleaf pines at Erambert Seed Orchard, Miss. Symptoms included copious pitching, particularly on slash pine terminals, raising the possibility that pitch canker might be involved, but several attempts to isolate the pitch canker causal organism, *Fusarium lateritium* f. *pini,* were unsuccessful. Much of the damage may have been due to extensive defoliation by the pine needle midge, *Contarinia* sp., which occurred in the orchard in 1974. A survey in November 1975 indicated that incidence of terminal dieback in the orchard was considerably less than 1 percent. Sampling and laboratory analysis disclosed the presence of Dutch elm disease, Verticillium wilt, and Cephalosporium wilt on winged elms *(Ulmus alata)* on the Vicksburg National

F–700013

Figure 24.—One of the white oaks in southern Arkansas that died in 1975 from an undetermined cause.

F–523698

Figure 25.—Cankers caused by lanterns hung on trees in recreation areas.

Military Park, Miss. Approximately 50 trees were affected in 1974 and an equal number in 1975.

A survey of cottonwood plantations along the Mississippi Delta of Arkansas, Louisiana, and Mississippi failed to reveal any serious disease problems. Plantations surveyed ranged in age from 1 to 11 years. Foliage diseases were prevalent. These included Septoria leaf spot, *Septoria musiva* Peck; Melampsora leaf rust, *Melampsora medusae* Thum; and a leaf spot caused by *Cercospora populina* E. and E. As in a similar survey conducted last year, up to 20 percent of trees were missing in some plantations.

A small number of planted live oaks *(Quercus virginiana)* on the grounds of the Lyndon B. Johnson Space Center near Houston, Tex., suffered defoliation and branch mortality. The cause of the problem has not been determined.

Cankers on softwoods and hardwoods of all age classes in recreation areas were attributed to heat generated by camping lanterns (fig. 25). As many as 10 such wounds were found around campsites and had caused girdling of up to 60 percent of the affected tree.

Decline and mortality of eastern red cedar over several areas in southeastern Tennessee are being investigated. The cause of the problem has not been determined.

NORTHEASTERN STATES (R–9)[6]

by

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Conditions in Brief

The spruce budworm continued to be the most devasting forest insect in the Northeast. Defoliation of over 5 million acres in 1974 prompted a 2.2 million-acre, aerial chemical-control project in Maine in 1975, the largest State-Federal forest spraying project ever undertaken in the United States. Acreage defoliated by the gypsy moth dropped off sharply in 1975, especially in New England and New York. The 91,000 acres defoliated represent approximately 60 percent of the 1974 defoliation. Fall cankerworm outbreaks occurred throughout the Northeast, especially in Pennsylvania, New York, and Wisconsin, where over 750,000 acres were defoliated. The oak leaf roller outbreak, which began about 8 years ago, declined in Pennsylvania. Populations of the oak leaftier complex also appeared to be on the decline. In the Lake States, defoliation of jack pine by the jack pine budworm dropped sharply, with Michigan reporting only 35,000 acres of light to moderate defoliation. Forest tent caterpillar outbreaks developed in Michigan, where 200,000 acres of oak and aspen were defoliated (table 2 Appendix).

Oak wilt incidence was static to slightly

[6] Includes forest lands in Connecticut, Delaware, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin.

higher. The Huron-Manistee National Forest reported oak wilt for the first time, with losses in many State parks. Further south, in Missouri and Iowa, there was little change with the oak wilt problem. Dutch elm disease incidence was increasing, especially in the Lake States. Predictions for 1976 include heavy mortality in the northern sections of Minnesota, Wisconsin, and Michigan. Losses due to beech bark disease increased; mortality in the Catskill and Adirondack areas of New York was especially high. In Vermont and New Hampshire, high beech mortality occurred in most places where it is a major stand component. Reports of sulfur dioxide and ozone damage were widespread and numerous. White pine in the Lake States was particularly affected.

Status of Insects

Spruce budworm, *Choristoneura fumiferana* (Clemens). This pest continued to be the most serious conifer defoliator in the Northeast in 1975. Almost all the spruce fir type in Maine–7 million acres–were moderately to severely defoliated, and New York is expected to have approximately 5,000 acres of heavy defoliation in 1976. Elsewhere in the Northeast, the budworm populations predicted from massive moth flights that occurred in 1974 did not materialize.

The budworm was also a major problem in the Lake States, with Michigan reporting over 370,000 acres defoliated. Surveys in several counties showed that 112,000 cords of spruce and fir were lost to the spruce budworm. Pockets of heavy mortality occurred on the Hiawatha National Forest in upper Michigan, and approximately 60,000 acres were defoliated in northeastern Wisconsin. Minnesota also sustained heavy mortality as a result of budworm defoliation on approximately 100,000 acres.

The largest cooperative State-Federal forest aerial spray project ever undertaken in the United States was completed in June 1975. Approximately 2.2 million acres of spruce-fir forests in Aroostock, Piscataquis, Penobscot, and Washington Counties, Maine, were twice sprayed with Sumithion® at a rate of 2 ounces per acre; with Sevin® 4 Oil at 1 pound per acre; and with Zectran® at 0.15 pound per acre. Effectiveness of the project in reducing larval populations was 90 percent or more. Approximately 3,240 acres of spruce-fir plantations in northern New York were sprayed using carbaryl at 1 pound per acre.

About 4 million acres are being considered for possible spray application in Maine for 1976. Aerial damage survey data, biological evaluations, and cost/benefit analysis will have an influence on the final acreage proposed.

No projects are anticipated against the budworm outside of Maine. Massive moth flights predicted earlier did not occur in 1975; therefore, budworm populations are expected to decline in the remainder of New England and New York.

Fall cankerworm, spring cankerworm, and associated loopers, *Alsophila pometaria* (Harris) and *Paleacrita vernata* (Peck). Cankerworm infestations were at outbreak proportions in most of the Northeast in 1975. Infestations were reported in Indiana, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, Pennsylvania, Rhode Island, West Virginia, and Wisconsin. New York reported 93,000 acres defoliated by the cankerworm complex; Pennsylvania, 362,000 acres; and Wisconsin, 300,000 acres. The linden looper was the predominant species associated with the cankerworm in New York.

Approximately 4,000 acres were sprayed with Sevin® 4 Oil in Massachusetts this year Considerable spraying was also done by private individuals and communities in the Milwaukee, Wis., area and the Twin Cities area of Minnesota. Approximately 20,000 acres may have to be treated next year in Pennsylvania to prevent economic losses in high-use residential and recreation areas.

Gypsy moth, *Lymantria dispar* (L.). Gypsy moth populations in New York, New England, and Pennsylvania declined significantly in 1975. The most dramatic decreases occurred in New England and New York, where total acreage infested dropped to about one-third of the 1974 figures. Among States with well-established infestations, only New Jersey showed an increase over 1974 activity As shown in Table 3 (Appendix) total acres defoliated decreased from 750,895 in 1974 to 464,-361 in 1975.

During 1975, a total of 48,579 infested acres were treated in New Jersey, New York, Penn-

sylvania, and Rhode Island. Additional acreage was treated in Michigan and Maryland as part of the regulatory program. Table 4 (Appendix) compares the acreage treated for gypsy moth in 1974 with that for 1975.

Disparlure-baited traps in the Northeast captured male moths in several new counties of Michigan, Ohio, New York, and Wisconsin. Moths were not trapped in Ohio where treatments were applied in 1974 and 1975. The number of moths trapped in Michigan totaled 174 in 159 traps. This compares with 1,828 moths captured in 1,039 traps in 1973 (21 counties), and 495 moths captured in 436 traps in 1974 (9 counties). The number of moths captured in Cook County, Ill., increased sharply. In 1974, only 12 moths were captured in Cook County, as opposed to 191 in 1975. Nevertheless, intensive surveys in this area failed to reveal any egg masses.

Release of gypsy moth parasites continued on a large scale throughout much of the Northeast. Over 2,675,000 parasites were released in Pennsylvania, New York, New Jersey, Rhode Island, West Virginia, and Wisconsin. Species of the genus *Apanteles* made up about 38 percent of the total released within these States. Indications are that gypsy moth populations will continue to decline in 1976.

Oak leaf roller, *Archips semiferanus* (Walker). The outbreak of this insect, which started in 1967, appeared to be over, but in 1975, 1,700 acres were defoliated in Pennsylvania, with severe tree mortality over much of the outbreak area. In Pennsylvania, a survey of two out of three infested counties revealed a total loss of 108 MMBF of sawtimber and 47 million cubic feet of pulpwood. The total value of wood destroyed was estimated to be $3.2 million. In 1975, 36,334 acres were treated with Dylox to control *A. semiferanus.*

Oak leaf tier complex, *Croesia albicomana* (Clemens), etc. This complex defoliated approximately 3,000 acres in New Jersey, and populations appeared to be increasing. Severe defoliation occurred on 3,000 acres of high value red oak in Wisconsin, but these populations were declining. An oak leaf roller, *Sparganothis pettitana* (Robinson), defoliated 300 acres of sugar maple trees and several "sugar bushes" in northern Vermont. This was the first record of this insect in populations large enough to cause noticeable damage. Oak leaftier populations in the rest of the Northeast appeared to be collapsing.

Jack pine budworm, *Choristoneura pinus* Freeman. Population decreased dramatically in Michigan this year, with only 35,000 acres of light to moderate defoliation. Mortality from the heavy defoliation of 1974 resulted in a loss of over 53,000 cords of jack pine on two of the State Forests surveyed. Wisconsin reported 50,000 acres of varying degree of defoliation.

Forest tent caterpillar, *Malacosoma disstria* Hubner. The forest tent caterpillar populations in lower and upper Michigan exploded, with over 200,000 acres defoliated; heavy moth flights also occurred in upper Michigan on the Ottawa National Forest. Indiana reported about 6,000 acres of defoliation on lands of mixed ownership, and in New England, light infestations were detected in Vermont and New Hampshire.

Large aspen tortrix, *Choristoneura conflictana* (Walker). Defoliation by this insect was reported in Minnesota, Vermont, and Wisconsin. In Wisconsin, portions of two counties were severely defoliated, causing concern among local residents. Approximately 11,500 acres were severely defoliated in Vermont, but the infestation in Minnesota declined to the point where defoliation was virtually undetectable from the air. Mortality resulting from past defoliation by this insect occurred on poor aspen sites.

Fall webworm, *Hypantria cunea* (Drury). Fall webworm populations ranged from very light to heavy. Ohio, Wisconsin, and Illinois experienced low population levels statewide; Illinois and Missouri reported moderate infestation levels; and West Virginia, New Jersey, New York, and New England recorded moderate to heavy activity. Fall webworm populations were also heavy in southern Michigan, where black walnut was the favored host.

Arborvitae leafminer, *Argyresthia thuiella* (Packard). Populations of this insect exploded on the Lower Peninsula of Michigan, where an estimated 130,000 acres were damaged. Defoliation was noticeable in nearly every area of the northern Lower Peninsula and is expected to continue at high levels in 1976. The leafminer was also detected in areas of New Hampshire.

Larch sawfly, *Pristiphora erichsonni* (Hartig). Populations of this sawfly increased in Michigan, New York, Maine, and Wisconsin, while those in Minnesota, New Jersey, Vermont, and New Hampshire decreased. The parasite *Olesicampe benefactor* was released in selected larch stands in Minnesota and New York to control the pest.

Larch casebearer, *Coleophora laricella* (Hubner). This insect, along with the larch sawfly, defoliated 20,000 acres in New York. Vermont also reported several small infestations of this pest. Malathion was used at the William Putnam Seed Orchard, Vt., to control the casebearer. Populations are expected to increase in New York in 1976.

Red pine scale, *Matsucoccus resinosae* Bean and Godwin. A survey conducted last winter in New Jersey revealed 31 residential properties with 1,015 infested trees. The infestation in Connecticut spread rapidly north and east into Fairfield, New Haven, Litchfield, Hardford, Middlesex, and New London Counties, and in New York, the infestation continued to spread northward, causing mortality of red pine in Westchester, Putnam, Suffolk, Nassau, and Orange Counties. Long Island was also partially infested.

White pine weevil, *Pissodes strobi* (Peck). Population levels were increasing in portions of southern Maine. Large populations were also evident in New York and Vermont and were increasing in New Hampshire. Spraying to control this insect in Maine was done by individual landowners. Approximately 200 acres of State-owned land will be treated in New York this fall.

Pine root collar weevil, *Hylobius radicis* Buchanan. Damaging populations of this pest were detected on Scotch pine Christmas tree plantations in Michigan, Minnesota, and Wisconsin. Another pine root weevil, *Hylobius rhizophagus* (Millers, Benjamin and Warner), was also reported causing higher-than-normal tree mortality in Wisconsin and Michigan.

Pine sawflies. Four species of sawflies caused notable damage this year. The balsam-fir sawfly, *Neodiprion abietis* (Harris), exploded in Minnesota with as many as 50 colonies per tree being reported; the jack-pine sawfly, *Neodiprion pratti banksianae* Rohwer, defoliated 5,000 acres of jack pine in Upper Michigan; scattered populations of the introduced sawfly, *Diprion similis* (Hartig), plagued Scotch, jack, and white pine in Minnesota, Michigan, and Wisconsin; and several plantations were damaged in Michigan, West Virginia, and Wisconsin by the red-headed pine sawfly, *Neodiprion lecontei* (Fitch).

Bark beetles. *Ips pini* (Say) infestations occurred on scattered jack and red pine plantations on lighter soils in northern Wisconsin. Bark beetle problems associated with summer thinnings and timber sales were higher than normal this year in Wisconsin and Michigan. These infestations were probably triggered by an extended period of hot, dry weather in July and August.

West Virginia personnel reported a higher incidence of southern pine beetle this year.

Spittlebugs, *Aphrophora parallela* (Say), and *A. saratogensis* (Fitch). Pine spittlebug nymphs and their conspicuous spittle masses were reported in large numbers from Wisconsin, Michigan, and Maine. Maine populations were at an alltime high. Saratoga spittlebug populations were also high in Maine, northern Wisconsin, and northern Michigan. In Wisconsin, however, 85 acres of red pine were successfully treated.

Other insects. Tip moths and shoot moths, *Rhyacionia spp.*, were of concern in West Virginia, Indiana, and Missouri, where they attacked Scotch pine plantations. West Virginia and Missouri expect an increase in damage in 1976. The Asiatic oak weevil, *Cyrtepistomus castaneus* (Roelofs), defoliated approximately 1,000 acres in Pochontas County, W. Va. Damage was also evident throughout Missouri. The oak defoliating grasshopper, *Dendrotettix quercus* (Packard), caused spotty defoliation on scrub oak in west-central Wisconsin. In Marienette County, Wis., grasshoppers and walkingsticks defoliated about 2,600 acres; some defoliation also occurred in Missouri. Walkingsticks, *Diapheromera femorata* (Say), attacked forests in the Lake States as well as in Missouri and West Virginia. Defoliation was light to moderate throughout west-central Wisconsin counties and ranged from light to heavy in the central part of Minnesota. West Virginia reported heavy defoliation of black walnut locust and oak in Mineral County.

Moderate to heavy feeding occurred in four

Missouri counties, and sparse populations were also observed throughout other southern Missouri counties.

Large populations of lace bugs, *Corythucha* spp., were reported attacking elm, oak, and basswood in Minnesota and Wisconsin. Much concern was expressed by the public because the browning symptoms of lace bug attack resemble those of Dutch elm disease and oak wilt. Datana caterpillars were numerous in Illinois and West Virginia. The yellow-necked caterpillar, *Datana ministra* (Drury), caused heavy defoliation of pin oak in northern Illinois.

Damaging populations of the red-humped oakworm, *Symmerista canicosta* Franclemont, and the orange-humped mapleworm, *S. leucitys* Francelmont, collapsed because of heavy egg paratisim by *Telenomus* spp. and *Trichogramma* spp. The hemlock looper, *Lambdina fiscellaria* (Guenee), defoliated hemlock on 400 acres in two locations in Bradford County and 400 acres in eastern Pennsylvania; the western Pennsylvania outbreak of *Lambdina athasaria athasaria* (Walker) collapsed. Populations of the cherry scallop shell moth, *Hydria prunivorata* (Ferguson), declined, with defoliation totaling less than 2,000 acres in north-central Pennsylvania.

Balsam woolly aphid, *Adelges piceae* (Ratzeburg), populations infested 18,000 acres of fir in northern Vermont; aphid populations and fir mortality in New Hampshire were low and are expected to remain static in 1976. Heavy infestations of birch leafminer, *Fenusa pusilla* (Lepeletier), were reported in northern Wisconsin, northern Michigan, Minnesota, northern West Virginia, and throughout Vermont, Rhode Island, and New Hampshire. The elm leaf beetle, *Pyrrhalta luteola* (Muller), was a pest in Missouri, southern Michigan, and in parts of Vermont. New Hampshire populations declined in one county and increased in three others; in Missouri, infestations are expected to intensify in 1976. Damage by the locust leafminer, *Xenochalepus dorsalis* (Thunberg), was heavy in southeastern Ohio and in southwestern and central West Virginia; light defoliation also occurred in southeastern Indiana. In Vermont, the maple leafcutter, *Paraclemensia acerifoliella* (Fitch), defoliated over 31,000 acres. Defoliation combined with drought also posed a threat to trees being tapped for maple syrup. Leafcutter populations increased in New Hampshire and covered several thousand acres. Localized infestations also occurred in the northwestern Lower Peninsula of Michigan.

Status of Diseases

Oak wilt, *Ceratocystis fagacearum* (Bretz) Hunt. For the second year, new infections were located in the northern Lower Peninsula of Michigan, with oak wilt being reported from the Huron-Manistee National Forest for the first time. A survey of the Zumbro watershed in Minnesota revealed an annual loss of 25 MBF over 1,500 acres. Oak wilt in Missouri and Iowa appeared to be static.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor. This disease has been reported from every county in Michigan and Iowa, and from all but one in Wisconsin. Heavy losses are expected next year in upper Michigan, northern Wisconsin, and Minnesota. In Michigan cities with good sanitation and root graft control, losses were reduced to low levels.

Cytospora canker of aspen, *Cytospora chrysosperma* (Pers.) Fr. Cytospora canker on the stems of aspen was reported in three northeastern Wisconsin counties and in northern Michigan. Many of the infected trees were confined to stress areas and were either dead or dying.

Diplodia tip blight, *Diplodia pinea* (Desm.). This disease was found on dying red pine shoots at Griffith State Nursery at Wisconsin Rapids. Similar shoot mortality was also observed at the Hayward Nursery in Wisconsin, but the same causal fungus could not be isolated. Shoot mortality appeared to be associated with root pruning operations. Tip blight also caused damage to red pine stands in Minnesota, Long Island, New York, Martha's Vineyard, Massachusetts, and New Jersey. In the coastal area, Austrian pine was also affected.

Chestnut blight, *Endothia parasitica* (Murr.) A and A. Minnesota, which is outside the original range of the American chestnut, escaped the ravages of the blight. One of the small plantations in the State, however, was infected, and nonresistant trees were rapidly killed.

Nectria canker, *Nectria* spp. A survey by the Forest Service in the Lake States revealed that this disease appeared to be a problem in a zone 15 miles wide along the Great Lakes shorelines.

Septoria leaf spot, *Septoria musiva* Pk. This leaf spot was common on balsam poplar throughout the Lake States and was responsible for premature leaf drop in northern Michigan.

Butternut dieback and canker, cause unknown. Widespread dying of butternut was first reported in Wisconsin in 1967. The disease was active in northeastern Iowa, where it also attacked walnut.

Scleroderris canker, *Scleroderris lagerbergii* Gremmen. New infections were reported on 200 acres of young red pine in Luce County, Mich. During 1975, red pine planting stock was shipped from Toumey Nursery to lower Michigan. Because of the past incidence of scleroderris in Toumey Nursery, a survey was conducted to ensure that the disease had not been brought in on the stock. No scleroderris was detected during the survey, suggesting that the fungicide spray treatments at the nursery effectively protected the seedlings against the disease. Many new infection centers appeared in northern New York, and in Oneida, Lewis, and Franklin Counties, extensive mortality occurred in 40-year-old stands. All the hard pines in the Adirondack region were in jeopardy.

Dwarf mistletoe, *Arceuthobium pusillum* Peck. Dwarf mistletoe continued to plague black spruce stands in the Lake States. A 1975 survey of the Chippewa National Forest showed a widespread distribution throughout the forest, but it appeared to be of little economic importance.

Anthracnose, species of *Gnomonia, Gloeosoprium, Marssonina,* and others. The overall incidence of anthracnose appeared less severe than in recent years. Michigan, Iowa, Indiana, Pennsylvania, and Missouri reported widespread occurrence statewide, but apparently of less severity than in the past.

White pine blister rust, *Cronartium ribicola* Fisch. White pine blister rust continued to be a problem in the Lake States. A Bureau of Indian Affairs survey in northern Minnesota and Wisconsin showed that most areas did not have enough stems per acre to justify pathological pruning. The Wisconsin Department of Agriculture pruned several areas in an effort to control blister rust.

Red pine shoot blight, *Sirococcus strobilinus* (Pruess). Several cooperative studies were underway in Wisconsin to determine if removal of infected overstory trees is an effective control measure. Fungicides were also being tested to determine if the infection could be prevented in seedlings. One new infection was reported in Minnesota.

Beech bark disease. Beech bark disease is caused by a combination of beech scales, *Cryptococcus fagi* Baer. and *Xylococculus betulae* (Perg.) Morris, and a fungus, *Nectria coccinea var. faginata* Loh., Wats. and Ay. In Vermont, severe beech mortality due to this complex can be found wherever beech occurs in any quantity. The annual loss in Vermont exceeds 90 MMBF in large sawtimber stands. The disease incidence was heavy throughout stands in the Adirondack and Catskill Regions. A new infestation was found in Cattarauyus County, the westernmost infestation yet known in New York. New Hampshire was experiencing heavy beech mortality in most of their stands, and in Pennsylvania, *Nectria* was observed along the eastern border of Tioga County, a spread of 25 miles west from the previously known boundary.

White pine root decline, *Verticicladiella proceri* (Kend.) This disease was reported in plantations in Iowa and Ohio, and was observed in Pennsylvania for the first time, where it killed 5 percent of the trees in several plantations in Greene and Juniata Counties.

Brown spot needled blight, *Scirrhia acicola* (Dearn.) In Wisconsin, although there were no new reports of brown spot infection in Scotch pine Christmas tree plantations, growers in the west-central part of the State continued to spray previously infected plantations as a preventive measure. Brown spot also threatened Scotch pine Christmas tree plantations in Missouri, where infections have become serious enough to apply control measures.

Verticillium wilt of maple, *Verticillium* spp. This wilt was widespread in Iowa, Pennsylvania, and southern Indiana but was of no immediate concern. The disease seemed worst when coupled with drought, as occurred in southern Indiana this year.

Lophodermium needle cast, *Lophodermium pinastri* (Schrad.) Chev. This needle cast was widely reported throughout Wisconsin and eastern Pennsylvania. In Wisconsin, browning was noted on red pine sawtimber and pole-size trees, as well as on nursery seedlings in two counties. The disease was also isolated from 3–0 nursery stock grown at the F. G. Wilson State Nursery, Wis. Since only three Scotch pine Christmas tree growers in Wisconsin treated for lophodermium in 1975, the 1974 fungicide control program was considered successful.

In Pennsylvania, the disease was widely scattered over 3,790 acres of pitch pine in several counties and was generally distributed throughout the eastern part of the State. Indiana also reported an incidence of *L. pinastri* on Scotch pine and spruce Christmas trees.

Sweetfern rust, *Cronartium comptoniae* Arth. Sweetfern rust was detected for the first time in Maryland this year. About 55 percent of the trees on a 440-acre loblolly pine plantation in Worchester County showed symptoms. Delaware reported a high incidence of sweetfern rust in north central Sussex County.

Phytophthora root rot, *Phytophthora citricola* Sawada *Sensu* Waterhouse. This fungus caused heavy mortality at the Jasper-Pulaski State Nursery, Ind., where over 50 percent of the black walnut seedlings were killed.

A mycorrhizal survey of two Federal nurseries in the Lake States revealed that approximately 20 to 25 percent of the feeder roots on the 3–0 red pine stock were mycorrhizal. In an attempt to increase the percentage of feeder roots that are mycorrhizal, fungi were introduced into the nursery beds.

Pine seedling mortality, cause unknown. In lower Michigan, mortality of outplanted jack pine stock occurred on 40 to 120 acres; red pine stock mortality outplanted from the Eveleth Nursery, Minn., was also unusually high.

Air pollution. A needle blight of white pine, possibly caused by sulfur dioxide or ozone, was conspicuous in central Wisconsin. About 10 percent of the plantation trees were affected in Columbia, Green, Green Lake, Marquette, and Waushara Counties. This condition was also apparent in a 10- to 15-square-mile area in parts of Clarks and Wood Counties. Similar symptoms on white pines were reported throughout the Lake States; ozone damage to white pine was also reported in several areas of New England. Pennsylvania reported air pollution to be widespread, but not as noticeable as last year's. In Missouri, sulfur dioxide was reported responsible for damage to pines and hickories throughout a 1,200-acre area.

Animal damage. Pine Meadow vole populations caused severe damage in Scotch and red pine plantations in most counties in north-central Wisconsin; losses were estimated at several million trees. In Vermont, an estimated 30,000 Scotch pines were destroyed by mice. Starling excrement caused chlorosis and terminal damage to white pine in a small area of southern Pennsylvania.

Physiological disorders. Needle droop, a physiological problem caused by water leaving the current year's needles faster than it can be absorbed by the roots, was found throughout northern Wisconsin, Michigan, and Minnesota. The problem was most pronounced on red pine. Iron chlorosis was widespread on white oak in northeastern Iowa and in parts of southern Minnesota and Wisconsin.

APPENDIX

TABLE 1.—*Acres of aerially visible western spruce budworm defoliation, Region 1, 1973, 1974 and 1975*

Area, by State	Number of Acres Defoliated		
	1973	*1974*	*1975*
Idaho			
Clearwater National Forest	414,680	591,479	634,830
Idaho Panhandle National Forests	146,000	204,841	189,617
Nezperce National Forest	1,321,000	1,182,823	7,040 [1]
Subtotal	1,881,680	1,979,143	831,487
Montana			
Beaverhead National Forest	14,500	48,770	240,990
Bitterroot National Forest	347,000	262,998	402,504
Deerlodge National Forest	78,320	268,237	271,629
Flathhead Indian Reservation	119,560	104,679	105,705
Flathead National Forest	120,090	110,873	111,219
Gallatin National Forest	11,400	54,026	337,929
Helena National Forest	44,680	259,752	473,937
Kootenai National Forest	—	—	3,606
Lewis and Clark National Forest	350	18,534	7,367
Lolo National Forest	931,000	1,033,440	1,000,600
Subtotal	1,666,900	2,161,309	2,955,486
Wyoming			
Yellowstone National Park	17,280	39,933	111,972
Total	3,565,860	4,180,385	3,898,945

[1] Entire Nezperce National Forest was not surveyed for western spruce budworm.

TABLE 2.—*Extent of major defoliator outbreaks in the Northeast, 1975*

State	Insect			
	Spruce budworm	*Gypsy moth*	*Cankerworm Complex*	*Total*
Connecticut	—	63,411	—	63,411
Maine	7,000,000	110	—	7,000,110
Massachusetts	—	17,900	—	17,900
Michigan	166,200	—	—	166,200
Minnesota	105,000	—	—	105,000
New Jersey	—	55,400	—	55,400
New York	—	9,275	93,000	102,275
Pennsylvania	—	317,800	362,000	679,800
Rhode Island	—	435	—	435
Vermont	—	30	—	30
West Virginia	—	—	3,000	3,000
Wisconsin	60,000	—	300,000	360,000
Total	7,331,200	464,361	758,000	8,553,561 [1]

[1] Includes all noticeable defoliation, assumed to be in the moderate to heavy category.

TABLE 3.—*Acres defoliated by gypsy moth in Northeastern States in 1974 and 1975.*

State	Acres Defoliated 1974	Acres Defoliated 1975	Percent change
Connecticut	120,980	63,411	−48
Maine	850	110	−87
Massachusetts	76,903	17,900	−77
New Hampshire	—	—	—
New Jersey	28,102	55,400	+49
New York	42,350	9,275	−78
Pennsylvania	479,590	317,800	−34
Rhode Island	2,120	435	−79
Vermont	—	30	—
Total	750,895	464,361	−38

TABLE 4.—*Acres treated for gypsy moth in the Northeastern States in 1974 and 1975.*

State	Acres treated 1974	Acres treated 1975	Percent Change
New Jersey	69,744	13,175	−81
New York	23,000	2,904	−87
Pennsylvania	72,900	30,000	−59
Rhode Island	87,200	2,500	−97
Total	252,844	48,579	−81

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